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PUBLIC NOTICES

Ministry of Transport.
ARTERIAL ROADS — GREATER LONDON.
EAST HAM AND BARKING BY-PASS.

The Minister is prepared to receive TENDERS for CONSTRUCTION and SURFACING WORK in connection with sections of the East Ham and Barking By-pass Arterial Road, Essex.

Forms of Tender, conditions of Tender, conditions of contract, bill of quantities and specification may be obtained from the Chief Engineer, Roads Department, Ministry of Transport, 7, Whitehall-gardens, S.W. 1, upon payment of a deposit of £25.

This amount will be returned to the tenderer if his Tender is a bona fide one and has not been withdrawn prior to the definite acceptance of a Tender by the Minister.

The drawings may be inspected at the offices of the Ministry, and copies of the Tender documents will be available on and after Wednesday, 21st July, 1926.

Tenders, on the official form, accompanied by a fully priced bill of quantities and schedules of prices and enclosed in a sealed envelope, endorsed "Tender for Construction and Surfacing East Ham and Barking By-pass," must reach the undersigned by 10 a.m. on Friday, the 6th August, 1926.

The Minister does not bind himself to accept the lowest or any Tender.

Dated this 17th day of July, 1926.

H. H. PIGGOTT.
Assistant Secretary.

Ministry of Transport. 2917

The Director - General,
India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. 180 COPPER FIRE-BOX PLATES for LOCOMOTIVES.
2. 1500 SUPERHEATER FLUE TUBES.
3. 15,600 AXLE-BOXES for CARRIAGES and WAGONS.
4. 8850 LAMINATED BEARING SPRINGS and 1000 BACK PLATES for CARRIAGES and WAGONS.
5. 245 TONS CHAIR and SLEEPER BOLTS.
6. METALLIC and LAVATORY FITTINGS for CARRIAGES.
7. 30,725 HELICAL and VOLUTE SPRINGS for LOCOMOTIVES, CARRIAGES and WAGONS.

Tenders due on the 6th August, 1926, for Nos. 1 to 5, and on the 10th August, 1926, for Nos. 6 and 7.

Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returnable. 2948

BOMBAY BACK BAY RECLAMATION SCHEME.
The Government of Bombay invites TENDERS for the RECLAMATION by Dry Filling of Earth or other approved Material of BLOCK No. 2 of the BACK BAY RECLAMATION AREA. The quantity of filling required is about 55 million cubic feet.

Copies of the forms of Tender, specifications, &c., may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, London, on payment of the sum of Four Guineas, which will be returned to firms submitting bona fide Tenders.

Tenders must be delivered to the Office of the DIRECTOR OF DEVELOPMENT, Bombay, by 23rd October, 1926, and must be accompanied by a deposit of Rs. 5000, which will be returned to unsuccessful tenderers. 2950

Assistant Engineers (5)
REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other diplomas or distinction in engineering as the Secretary of State may decide in any particular case or have completed articles with a civil engineer of good standing, and have passed the Examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/14378. 2847

Assistant Engineers (6)
REQUIRED by the GOVERNMENT of NIGERIA for the Public Works Department for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 30 years of age, unmarried, must have passed the examination for A.M.I.C.E. or possess a degree in civil engineering recognised by the Institution as exempting from Parts "A" and "B" of the examination. They must have proper technical training, and preferably have had not less than two years' subsequent experience on large engineering or municipal works. Candidates possessing other civil engineering qualifications may apply.—Applications should be made at once, by letter, stating age, qualifications, and experience, also whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14485. 2918

University of Leeds.
DEPARTMENT OF ENGINEERING.

The Council will shortly proceed to the APPOINTMENT of TWO DEMONSTRATORS in CIVIL and MECHANICAL ENGINEERING, at a salary of £300 in each case.

Further particulars may be obtained from the REGISTRAR, The University, Leeds, who will receive applications up to the 29th July. 2852

The Government of Madras REQUIRE an ASSISTANT EXECUTIVE ENGINEER for COCHIN HARBOUR WORKS.

QUALIFICATIONS.—Age 25-35 years, degree in engineering of a recognised University of Great Britain or Ireland, three or four years' training under a Chartered Civil Engineer of standing, with two or three years' further experience on public works, preferably harbour works; must be or become an Associate Member of the Institution of Civil Engineers.

Five years' agreement. Pay at the rate of Rs. 750-50-950 per mensem. Initial pay according to qualifications and experience. Free passage to India and return on satisfactory termination of agreement. Provident Fund. Strict medical examination.

Forms of application and further particulars should be obtained from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 14th August, 1926. 2908

University of Birmingham.
FACULTY OF SCIENCE.
ENGINEERING DEPARTMENTS.

I.—MECHANICAL ENGINEERING.
"CHANCE" PROFESSOR: F. W. BURSTALL, M.Sc., M.A. (Cantab.), M.I. Mech. E.
LECTURER: R. C. PORTER, M.Sc. (Vict.), A.M.I.C.E.
DEMONSTRATOR: S. J. ELLIS, B.Sc., A.M.I.C.E.
LECTURER ON MACHINE DESIGN: P. H. BODEN, B.Sc.
ASSISTANT LECTURER ON MACHINE DESIGN: H. P. DEAN, B.Sc.

II.—CIVIL ENGINEERING.
"BEALE" PROFESSOR: CYRIL BATHO, M.Sc., D.Sc., B.Eng.
LECTURERS: R. C. PANTON, M.Sc., A.M.I.C.E. H. W. COULTAS, M.Sc., M.I. Mech. E. T. H. P. VEAL, B.Sc., A.M.I.C.E.
LECTURER ON TOWN PLANNING: W. HAYWOOD, F.R.I.B.A.

III.—ELECTRICAL ENGINEERING.
PROFESSOR: WILLIAM CRAMP, D.Sc., M.I.E.E.
LECTURERS: E. J. KIPPS, M.Sc., M.I.E.E. G. M. HARVEY, M.Sc., B.Eng.
ASSISTANT LECTURER: L. G. A. SIMS, M.Sc.

THE FULL COURSES EXTEND OVER FOUR YEARS, and students who enter after Matriculation and pass successfully the examinations at the end of each year will be ENTITLED TO THE DEGREE OF BACHELOR OF SCIENCE in Engineering.

THE SESSION 1926-27 COMMENCES ON OCTOBER 4th, 1926.

For detailed syllabus of the Faculty with full particulars of University Regulations, Lectures and Laboratory Courses, Fees, &c., apply to the REGISTRAR. 2943

The Royal Technical College,
GLASGOW.
DEPARTMENTS OF ENGINEERING.

MECHANICS AND MECHANICAL ENGINEERING: Professor ALEXANDER L. MELLANBY, D.Sc., M.I. Mech. E. Associate Professor WILLIAM KERR, Ph.D., A.R.T.C.
ELECTRICAL ENGINEERING: Professor STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M. Inst. C.E.
CIVIL ENGINEERING: Professor GEORGE MONCUR, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
MINING ENGINEERING: Professor DANIEL BURNS, M. Inst. M.E.
CHEMICAL ENGINEERING: Professor of Technical Chemistry: THOMAS GRAY, D.Sc., LL.D., Ph.D., F.I.C.

Complete Courses of Instruction are provided, qualifying for the Diploma of the College and for the Degree of B.Sc. in Engineering of Glasgow University. Composition fee 25 guineas per annum.

SESSION 1926-7 BEGINS on TUESDAY, SEPTEMBER 21st.

Calendar, by post, 3s., and prospectus, gratis, may be obtained on application to the DIRECTOR. 2846

The South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. FIRE-BRICKS and CLAY.
2. C.I. CHAIRS and DISTANCE BLOCKS.
3. FIVE 4-WHEEL STEEL BRAKE VAN UNDERFRAMES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Fire-bricks and Clay," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 6th August, 1926, for items 1 and 2, and the 13th August, 1926, for item 3.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 2s. 6d. for each copy of Specification No. 1, of 5s. for each copy of Specification No. 2, and of 10s. for each copy of Specification No. 3.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1, 20/7/26. 2900

PUBLIC NOTICES

County Borough of Halifax.
ELECTRICITY COMMITTEE.
STEEL SHEET PILING—ELECTRICITY WORKS.

TENDERS are INVITED for STEEL SHEET PILING at the Electricity Works, Halifax.

Plans, specification, and form of Tender may be obtained at the office of the Borough Engineer, Crossley-street, Halifax, on payment of a deposit of One Guinea (£1 1s.) (cheques to be made payable to the "Halifax Corporation"), which will be returned on receipt of a bona fide Tender.

Tenders, endorsed "Piling—Electricity Works," must be delivered to the undersigned not later than the first post on Saturday, 7th August, 1926, and persons should state, when tendering, whether or not they are on the King's Roll.

The persons whose Tenders are accepted will be required to observe the Fair Contracts Clauses adopted by the Corporation.

The Committee do not bind themselves to accept the lowest or any Tender.

By Order,
PERCY SAUNDERS,
Town Clerk.

Town Hall, Halifax. 20th July, 1926. 2968

City of Stoke-on-Trent.
ELECTRICITY DEPARTMENT.

The City Council invite TENDERS for the SUPPLY and ERECTION of the following :—

ONE 10,000 K.W. TURBO-ALTERNATOR and CONDENSING PLANT (Contract No. 2614).
ONE NATURAL DRAUGHT COOLING TOWER (Contract No. 2615).
IRONCLAD L.T. 3-PHASE SWITCHGEAR (Contract No. 2616).

Tender forms, specification and conditions of contract may be obtained from the City Electrical Engineer, St. George's Chambers, Wolfe-street, Stoke-on-Trent, on payment of a deposit of £2 in respect of each contract, which sum will be refunded if a Tender is duly submitted by the contractor.

Tenders are to be delivered to the undersigned in an envelope which will be supplied with the Tender form not later than the 7th September, 1926.

E. B. SEARLEY,
Town Clerk.

Town Hall, Stoke-on-Trent, 17th July, 1926. 2939

TENDERS INVITED.
The County of London Electric Supply Co., Ltd.
BARKING POWER STATION EXTENSIONS, 1926.

The County of London Electric Supply Company, Ltd., are open to receive TENDERS for the SUPPLY and ERECTION at their Barking Power Station of a CENTRAL EVAPORATING EQUIPMENT.

Specifications may be obtained by manufacturers from the offices of the Company on application to the undersigned on or after the 26th July, 1926, on payment of a fee of £5 5s. for the first copy and £2 2s. for every subsequent copy.

Sealed Tenders, marked "Tender for Central Evaporating Equipment," should be addressed to the undersigned, and lodged at the registered office of the Company by Noon on the 23rd August, 1926.

Sums paid for any number of copies up to three will be refunded on receipt of a bona fide Tender.

The Company do not bind themselves to accept the lowest or any Tender.

F. C. McQUOWN,
Joint Manager and Secretary.

The County of London Electric Supply Co., Ltd., Moorgate-court, Moorgate-place, London, E.C. 2. 2940

The London and North-Eastern RAILWAY COMPANY are desirous of HIRING a number of SINGLE-CHAIN GRABS of about 40 cubic feet capacity, suitable for discharging coal from ship to wagon.

Particulars and terms to be submitted to the CHIEF MECHANICAL ENGINEER, North-Eastern Area, Darlington. 2972

Tyne Improvement Commission.
NEW QUAY, TRANSIT SHED, PASSENGER PLATFORM, RAILWAYS, &c., AT THE RIVER WALL, ALBERT EDWARD DOCK, NORTH SHIELDS.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the CONSTRUCTION of a NEW QUAY, TRANSIT SHED, PASSENGER PLATFORM, RAILWAYS, &c., at the River Wall, Albert Edward Dock, North Shields.

Copies of the form of Tender, conditions of contract, specification and drawings may be obtained on and after the 31st instant on application to the undersigned on payment of a deposit of £10 10s., which sum will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed "Tender for New Quay," and addressed to "The Chairman, Tyne Improvement Commission, Newcastle-upon-Tyne," must be delivered at the undermentioned offices not later than Noon on Tuesday, the 31st August, 1926.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
ALBERT BLACKLOCK,
Secretary.

Tyne Improvement Commission Offices, Bewick-street, Newcastle-upon-Tyne, 16th July, 1926. 2941

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SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED for Straits Settlements, ELECTRICAL and MECHANICAL ENGINEER, with wide commercial and sales experience, to Manage established Engineering Agency and Contracting Business. Good salary to right man.—Address, stating age, P2106, The Engineer Office. P2106 A

WANTED, Fully Qualified CIVIL ENGINEER for pioneer work in new country with native labour, experience in Road Surveying and Laying Out Pipe Lines. Candidates should be single and energetic, with working knowledge of Spanish, able to leave at an early date.—Apply, Box C.E. (1), Mercico Publicity Service, Ltd., 14, New Cavendish-street, W. 1. 2961 A

GENERAL MANAGER WANTED by Well-known Firm of Engineers in the North. Age not exceeding 40. Must be thoroughly conversant with modern workshop methods of production and costs. Only those of approved ability and possessing first-class references need apply.—Applications to be addressed 2960, The Engineer Office. 2960 A

REQUIRED for Consultant's Office, BUILDING ENGINEER. Experience in Reinforced Concrete Design and Construction.—Address, with full particulars, P2110, The Engineer Office. P2110 A

REQUIRED for Consultant's Office, BUILDING ENGINEER. Experience in Structural Steel Work Design and Erection.—Address, with full particulars, P2111, The Engineer Office. P2111 A

DRAUGHTSMAN REQUIRED by Leading Lift Manufacturer in Midlands.—Address in first instance, stating age, experience, and wages required, 2956, The Engineer Office. 2956 A

WANTED, First-class CHASSIS DESIGNING DRAUGHTSMAN, with experience of Commercial Vehicles and Cars, in the designs office of a large engineering establishment in the North manufacturing commercial vehicles.—Address, giving age, wages expected, with copies of recent testimonials, 2970, The Engineer Office. 2970 A

DRAUGHTSMAN WANTED, Thoroughly Experienced in detailing Mechanical and Structural Work for Conveyor Plants, &c. State age, experience, and salary.—Address, 2953, The Engineer Office. 2953 A

DRAUGHTSMAN, with All-round Experience of the design, performance and construction of Low-level Jet Condensing Plants and Extraction Pumps, REQUIRED by an old-established firm. State full particulars of experience and salary required.—Address, 2867, The Engineer Office. 2867 A

REINFORCED CONCRETE SENIOR DESIGNER REQUIRED, with specialist experience in all types of structures. Permanent position and house available.—Apply, with summary of experience, stating age and salary required, to Department "D," THE BRITISH REINFORCED CONCRETE ENGINEERING CO., Ltd., Stafford. P2104 A

REQUIRED by a Public Authority, a First-class DRAUGHTSMAN, having experience in the design and detailing of Buildings, Bridges, Lock Gates, Jetties, and other Dock and Harbour Structures in Steel, Timber, and Reinforced Concrete. Must have a sound theoretical training and a practical knowledge of the various details of the above mentioned structures.

Commencing salary £350 per annum.

Reply, giving full particulars of age, training, experience, and present position, to F. L., Box 2388, Willing's, 20, King-street, W.C. 2. 2938 A

STRUCTURAL STEEL WORK.—Thoroughly Competent DRAUGHTSMAN REQUIRED (London area), capable of designing and detailing all classes of Structural Steel Work for Buildings, Quantities, &c. State full experience, age, and salary required.—Address, 2957, The Engineer Office. 2957 A

SITUATIONS WANTED

BRITISH ELECTRICAL ENGINEER (30). Good technical and practical engineering education, design, manufacture and sales experience in England and the Continent, acquainted with continental practice, speaking four languages, would CONSIDER responsible POST with reputable British firm, preferably in the Continent.—Address, P2100, The Engineer Office. P2100 B

CAPABLE ENGINEER, Aged 29 Years, Energetic, urgently REQUIRES POST, home or abroad; will take anything with prospects. Experienced boiler plants, steam and I.C. engines, all classes pumps, machinery, oil refining maintenance and bench construction. Used to control of large squads of native labour and speaks Hindustani. Excellent refs. —Address, P2042, The Engineer Office. P2042 B

ENGINEER (25), A.C.G.I., 3 Years Eng. College, 4 years shops, recently completed agreement with well-known firm of mechanical and electrical engineers, SEEKS PROGRESSIVE POST, works or office. —Address, P2107, The Engineer Office. P2107 B

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MISCELLANEOUS

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LANCASHIRE TRAVELLER is DESIROUS of KNOWING a SHEFFIELD FIRM specialising in Steel Reinforcement Fabric for Roads and Concrete Structures.—Address, P2109, The Engineer Office. P2109 I

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WASHED MUTTON CLOTH WIPERS, Guaranteed sterilised. Stocks held in London for immediate delivery. Goods packed for export. Trade supplied for re-sale.—Inquiries, 123, Latimer-road, W. 11. Park 4659. P2108 I

EDUCATIONAL

COACHING for INST. C.E. EXAMINATION. Personal or by correspondence.—To G. W. M. BOYCOTT, Assoc. M. Inst. C.E., Chandos House Palmer-street, Westminster, S.W. 1. 2808 B

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter. B.Sc.), and ALL ENGINEERING EXAMINATIONS, personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Eng., London, Assoc. M. Inst. C.E., Chartered Civil Engineer, M.R.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams., comprising hundreds of successes. Courses may commence at any time.—Apply to Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), A.M.I.C.E., &c., 8/11, TRAFFORD CHAMBERS, 58, SOUTH JOHN-STREET, LIVERPOOL. Telephone No. 1118 Bank Ex. 2.

AGENCIES

WANTED, AGENTS for Our First-class Progressive Surveying Instruments. Highest references of important British customers.—H. WILD, Ltd., Heerbrugg, Switzerland. 2914 D

FRENCH MANUFACTURER of Adhesive Composition for Pulleys is anxious to APPOINT AGENT for U.K.—Apply by letter, with references, to OFFICE COMMERCIAL FRANCAIS, 111/113, Queen Victoria-street, E.C. 4. P2105 D

GLASGOW HOUSE, Good Connection Scottish coal masters, OPEN CONSIDER SOLE AGENCY, Colliery Requirements any description.—Address, "COLLIERY," Wm. Porteous and Co., Advertising Agents, Glasgow. P2102 D

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LARGE MANUFACTURERS of TOOL STEEL, STEEL FORGINGS and STAMPINGS, &c., DESIRE AGENT on commission with own office; must have connection in Newcastle district. State fully terms and personal connection.

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PATENTS

KING'S PATENT AGENCY, Ltd. (Director, B. T. KING, C.I.M.E., Registered Patent Agent, G.B., U.S., and Canada). Inventions advice handbook and consultations free.—146a, Queen Victoria-street, London, E.C. 4. 40 years' refs. 'Phone: Central 682. 2754 H

MEANS FOR CONTROLLING THE CARBURETTORS OF INTERNAL COMBUSTION ENGINES USED FOR AVIATION PURPOSES.—The PROPRIETORS of BRITISH PATENT No. 186,353 are PREPARED to CONSIDER OFFERS for the PURCHASE of same and other PATENTS relating to Carburettors.—Communications please address to DICKER and POLLAK, Chartered Patent Agents, 20-23, Holborn, London, E.C. 1. 2935 H

THE PROPRIETOR of the PATENTS Nos. 230,750, 232,165 and 235,360, for "Improvements in or relating to Injectors for Mineral Oil Motors," "Improvements in or relating to Cylinder Heads for Internal Combustion Engines," and "Improvements in or relating to Fuel Pumps for Internal Combustion Engines," respectively, is DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE and otherwise on reasonable terms for the purpose of EXPLOITING the same and ensuring their full development and practical working in this country.—All communications should be addressed in the first instance to Haseltine, Lake and Co., Chartered Patent Agents, 28, Southampton-buildings, Chancery-lane, London, W.C. 2. 2902 H

THE PROPRIETOR of BRITISH PATENT No. 203,179, dated August 28, 1922, relating to "Improvements in Stookers," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, 28, East Jackson Blvd., Chicago, Illinois. 2886 H

THE PROPRIETOR of BRITISH PATENT No. 187,671, dated July 14, 1921, relating to "Improvements in Fluid Pressure Engines," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 2895 H

PATENTS

INSULATED WIRES.

THE ENGLISH PATENT No. 239,804, Concerning "An Improved Process for the Manufacturing of Wires Insulated by a Coating of Varnish," is FOR SALE.—Apply to Dr. ADOLF PAPENTIN HAMMIN, Westf., Germany, Westenwall 8. 2946 H

THE PROPRIETOR of BRITISH PATENT No. 189,278 (Pat. of Add.), dated September 20, 1921, relating to "Improvements in Mattress Roll Forming Machines," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—Inquiries to B. SINGER, Steger Building, Chicago, Illinois. 2950 H

THE PROPRIETOR of PATENTS No. 205,037, for "Improvements in Hardening Steel Articles;" and No. 219,958, for "Improvements in Furnaces for Heating Rock Drills and the like," is DESIROUS of ENTERING into LICENCE ARRANGEMENTS for the commercial use of the inventions, or would CONSIDER OFFERS for the PURCHASE of the PATENT RIGHTS.—Communications in first instance to JOHN P. O'DONNELL and CO., Chartered Patent Agents, 47, Victoria-street, London, S.W. 1. P2099 H

THE PROPRIETOR of BRITISH PATENT No. 150,286, dated August 21, 1919, relating to "Improvements in and relating to Centrifugal Pumps for Use with Pneumatically Operated Mechanisms," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to B. SINGER, Woolworth Bldg., New York, U.S.A. 2887 H

THE PROPRIETOR of BRITISH PATENT No. 111,089, dated 23rd October, 1916, relating to "Electric Welding Machines," is DESIROUS of DISPOSING of the PATENT RIGHTS or of NEGOTIATING for the GRANT of LICENCES to work thereunder. —All enquiries should be addressed to MEWBURN, ELLIS and CO., 70-72, Chancery-lane, London, W.C. 2. 2964 H

For continuation of Small Advertisements see page 3.

ROCK WAUGH DRILLS

The Moffat Tunnel

The Denver No. 17 model is widely used in the Moffat Tunnel, having been adopted after independent tests against two other makes. These tests proved that the Denver "17" drills 30·2% faster than one competitor and 16·6% faster than the other.

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DENVER

Denver Bulletin No. 170 gives full particulars of the No. 17. May we send it and arrange a demonstration under any conditions—the harder the better. Other lists on application.

Raymond

A Seven-Day Journal

Solid Helium.

A FORTNIGHT ago we noted the report that Professor W. H. Keesom, of Leyden University, had succeeded in solidifying helium, but were unable to give any details of the process he employed. In the current issue of *Nature* a letter appears from Professor Kessom himself announcing his achievement, and giving brief particulars of the method employed. On June 25th, the Professor states, helium was compressed in a narrow brass tube forming a connection between two tubes of German silver. The brass tubes and part of the two German silver tubes were immersed in a bath of liquid helium. When a pressure of 130 atmospheres was applied to the helium, the tube system appeared to become blocked, and when the pressure was lower by 1 or 2 atmospheres the system was open. The temperature of the liquid helium bath was somewhat uncertain during this experiment. By a reduction of the pressure on the liquid helium bath the same phenomenon was observed at a temperature of about 3·2 deg. Cent. absolute at 86 atmospheres, and at a temperature of about 2·2 deg. at 50 atmospheres. On July 1st the experiment was repeated. At a temperature of 4·2 deg. the phenomenon occurred at 140 atmospheres, and at 1·1 deg. at 26 atmospheres. From the regularity of these observations, it was concluded that the blocking of the tube system was being produced by the solidification of the helium. If the points are plotted, it will be found that the curve towards the origin tends to become parallel with the axis of temperature, and that it seems to imply that at absolute zero a pressure of some 16 atmospheres would be required to solidify helium. Finally, Professor Keesom states, helium was compressed in a glass tube provided with a magnetic stirrer, and the observations were confirmed, the stirrer being seen to stick when the helium solidified. In one experiment part of the substance was solid and part liquid. It was found possible to hammer the solid block with the stirrer when the stirrer was in the liquid part. No limiting surface between the solid and liquid parts could, however, be seen. Solid helium forms apparently a homogeneous transparent mass, having a refractive index, which differs only by an extremely small amount from that of liquid helium.

New Filtration Works at Walton.

ON Monday last, with no outward show and a minimum of ceremony, a most important addition to the equipment of the Metropolitan Water Board was put into service by Mr. Neville Chamberlain, the Minister of Health. The Board, in order to improve the supply of water in the south-eastern districts of its area, has just installed at its Walton pumping station a filtration plant, modelled on the latest plan, and furnished with the most up-to-date accessories. In any other city or town in the country the formal opening of such an installation as that which Mr. Chamberlain started to work would have caused no little stir and comment, instead of, as it did, passing off practically unnoticed by the community at large, for to describe it briefly the plant has been designed for a daily supply of twice-filtered, and, if necessary, sterilised water to the amount of 34,000,000 gallons, or enough to furnish a population of 1,000,000 persons with a *per capita* ration of 34 gallons every twenty-four hours. So vast, however, are, of necessity, the activities of the Board, that the new plant, though it could, by itself alone, satisfy the needs of such a city as, say, Birmingham, forms but a unit of a gigantic whole, and was brought into operation in the presence of but a small company, which was composed of very few others than members of the Board, officers of bodies directly or indirectly concerned with the water supply of London, and representatives of the various contractors who have been engaged on the work. We propose in future issues to describe in detail the whole plant, which comprises not only primary and secondary filters and chlorination plant, but also powerful pumping machinery, and possesses many interesting features.

A Geophysical Test.

THE geologists have for long taught us that it is the sea that is stable and the land that is mobile. It is at least easy to believe, although it may be difficult to prove, that in this statement there is fundamental truth. We can, for instance, readily conceive that there is a daily growth and diminution in the distance apart of two towns on the same latitude as a result of the expansion and contraction of the earth's crust as it faces the sun and turns its back to it. There are tides in the land as well as in the sea, and both must act to vary the distance between places on the earth's surface. And there are other possible and it may be more important causes leading to the same result. It has been suspected before that the relative positions of different points on the globe are not permanent, that there may be movements of the earth's crust, regular or irregular, of measurable and possibly considerable magnitude. The means of detecting such possible movements have, however, been lacking, but wireless signalling has now reached a stage at which it should be able to provide the required means. It is therefore with interest that we learn this week of the attempt so to apply it, which will be made between October 1st and December 1st this year. With the encouragement of the International Astronomical Union and of the International Geodetic and Geophysical Union wireless time signals will, during the period covered by the tests, be sent out three times daily from three principal stations situated substantially in the same latitude and approximately eight hours apart in longitude, namely, from stations at San Diego, California, at Algiers, and at Shanghai. Other stations will, it is anticipated, also transmit time signals in a concerted manner. Observatories receiving the signals will deduce from them their longitude relatively to the longitudes of the sending stations, and by repeating the process at intervals will be able with considerable accuracy to determine whether, and if so to what extent, their relative positions are subject to change. The tests, it would appear, will enable possible changes of relative longitude to be discovered, but not, or at least not directly, changes of relative latitude. Further, since the tests depend upon the correlation of time signals with astronomical observations, the relativitists will, we think, probably have something to say as to the interpretation of any apparent discrepancy of longitude that may be detected.

Thames Bridges Inquiry.

IT was announced on Monday by Mr. Baldwin in the House of Commons that the Royal Commission on Bridges over the Thames in the London area had now been constituted. The members of the Commission, Mr. Baldwin stated, would be Viscount Lee of Fareham (chairman), Sir Willoughby Dickinson, Viscount Hambleden, Professor C. E. Inglis, Sir William Plender, and Sir Lawrence Weaver. The Commission would be charged to survey the whole problem of cross-river traffic in London and to report at the earliest possible date on what provision should be made to meet future requirements. Particular consideration would be given to the proposals made in connection with Waterloo and St. Paul's bridges. While the majority of the gentlemen composing the Commission appear to have had extensive experience as members of Government Commissions on a wide variety of subjects, from demobilisation to the care of the mentally defective, it is not easy to understand why they should have been selected for the new Commission. Two of the commissioners may be described as soldier-politicians and a third as a barrister-politician. A fourth is a chartered accountant and a fifth an author trained as an architect. Dr. Inglis is professor of mechanism and applied mechanics at Cambridge University and is the only engineer, almost the only member with technical training, on the Commission.

Naval Shipbuilding in Japan.

FOR the next financial year the Japanese Ministry of Marine has drafted Naval Estimates amounting to £32,000,000, which is £8,000,000 more than those for the current year. This large increase is mainly due to the shipbuilding programme for which parliamentary sanction is about to be invited. That programme embraces four 10,000-ton cruisers, a group of 1700-ton destroyers, and five submarine cruisers of 2000 tons. These vessels are, of course, additional to the new construction credited to Japan in the official Return of Fleets. The cruisers Kako and Furutaka, laid down in 1922, have just been commissioned. They are sister ships of 7100 tons and 33 knots, their peculiar feature being the mounting of the main armament of six 8in. guns in separate gun-houses, three forward and three aft. The Aoba and Kinugasa, begun in 1924, have the same displacement, speed, and armament as the Kako, but in their case the six 8in. guns are paired in turrets, two at the bow and one astern. The four cruisers of the "Nachi" class, laid down in 1924–25, have a standard displacement of 10,000 tons and are to carry eight 8in. guns. Their speed has not yet been disclosed. According to the Return, twelve first-class destroyers are under construction, the first five being boats of 1400 tons, the others of 1800 tons. Twelve more destroyers are listed as "projected," but it is not quite clear whether they have actually been authorised. Twenty-six submarines of various classes are in hand. Of the first thirteen, the smallest displaces 770 tons and the largest 1970 tons. No details of the other submarines are given.

Electrical Equipment for Russia.

A RUSSIAN commission arrived in London a few days ago with a view to placing orders in different countries for the complete electrical equipment for the extension of six Russian power stations at a total cost of approximately £2,500,000. The commission proposes to avail itself of the credit facilities extended by the German manufacturers with the support of their Government, but the commission also has instructions to bring in manufacturers of other countries, provided credit facilities are agreed to. Questioned as to the prospects of getting the necessary terms of credit in England, in view of the fact that Russia was excluded from the countries which came under the British Government's export credit guarantee, Professor Polivanot, the chairman of the commission, is reported to have replied that English manufacturers had previously given credits to the Soviet Government and were doing so at the present time. He had, therefore, every reason to believe that credits would be available in the present instance. The extent of those credits might not be as large as that given by the German manufacturers with their guarantee, but orders would be placed, not on credit terms alone, but also with regard to the question of price, which for certain parts of the equipment might be more favourable in England. The orders to be distributed by the commission, which would have its headquarters in Berlin, would be placed in the respective countries by the Russian delegations. In England they would be placed through Arcos.

The Trades Disputes Act.

IN the House of Lords on Tuesday last Lord Banbury moved the second reading of the Bill to repeal the Trades Disputes Act of 1906. He alluded to the fact that the defects of that Act had been made manifest in the recent general strike. He thought the right thing was for the Government to bring in legislation, but as far as he knew, it was doing nothing, and he felt that action should be taken whilst the facts were fresh in the minds of the public. Lord Templemore moved that the debate be adjourned, not because he was out of sympathy with the Bill, but because he thought action ought to be left to the Government. He was supported by Viscount Dunedin. The Lord Chancellor then replied. He assured the House that the Government had taken the matter into its earnest consideration, and informed it that a Committee which had been sitting for some weeks, was on the point of making its recommendation to the Cabinet. He believed that the Government would find it necessary to propose legislation at an early date. Lord Banbury's Bill, which consisted of but one line, went too far in some respects and not far enough in others. He did not think it would be necessary to repeal the whole Act, and he thought it might be desirable to add clauses which would make it impossible for unions to penalise men who had remained at work. The ballot, also, might call for consideration, and the position of Civil Servants might have to be made clear. He believed that some legislation at a very early date would be found necessary, and he thought it would in the circumstances be inadvisable to proceed with the debate. Lord Banbury consented to the adjournment of the debate.

Wages in the Engineering Industry.

IT would appear that further action by the unions concerned with the engineering industry in connection with the long-standing demand for an all-round increase of 20s. in wages has now been definitely abandoned. The general strike is said to have inflicted a loss of £2,600,000 on the engineering industry, and while, before it, the employers were prepared to offer the men an increase of 2s. 6d. a week in their wages, after it, they found it impossible to offer any increase at all. The policy of the unions was to make the demand of the increase a local rather than a national matter, and in the first instance, at any rate, to concentrate their efforts on the London district. The members of the unions in that district had balloted in favour of enforcing their demand by strike action, but no steps were taken to give immediate effect to that verdict. On Tuesday of this week, July 20th, the London District Committee of the unions involved in the demand met the Executive Committee of the Amalgamated Engineering Union to consider the position. After the meeting it was announced that it had been decided to leave the matter in the hands of the Executive Committee, and that further consideration would be given to it at a future date, when conditions were more settled than at present. The interpretation placed on this announcement is that the Amalgamated Engineering Union is not prepared to continue the claim for a wages advance under present conditions either in London or elsewhere.

The White Star Line.

IN a Journal note which appeared in our issue of April 30th we referred to negotiations which had been begun between the Furness-Withy group and the International Mercantile Marine Company, of New Jersey, for the purchase of the White Star Line. In connection with these negotiations a purchase price of over £7,000,000 was mentioned. On the authority of Messrs. Morgan, Grenfell and Co. and Mr. P. A. S. Franklin, the president of the International Mercantile Marine Company, it is now announced that owing to present conditions and circumstances the negotiations have been terminated by mutual consent. This announcement is one which has occasioned some surprise both in London and New York. It is well known, however, that the shipping position in America is, to say the least, somewhat unsettled. Three ships of the United American Lines, the Reliance, Resolute, and Cleveland, all German-built ships, have recently been sold to the Hamburg-American Line, whilst the United States Shipping Board has indicated its desire to receive offers early in September for the ships of the United States Lines.

Can the Heat of Combustion of Coal be Turned Directly into Electric Energy?

By JOHN G. A. RHODIN, F.I.C.

As a scientific curiosity we can say that the problem indicated by the title of this article has been solved, but as the basis of a practical industry it still remains; even the fundamental idea of a solution is lacking. In the 'nineties of last century, when the industrial application of electrolysis was a burning question, many attempts were made to produce a voltaic combination utilising coal or carbon as the positive element. The directions followed included, amongst others, Mond's attempt to produce a gas battery, using water gas on the one side and air on the other. One may assume that Mond's fundamental idea was to produce the equivalent of hydrogen corresponding to the carbon in the coal, and hence a gas with a minimum of carbon monoxide and maximum of carbon dioxide, which latter could be easily removed, leaving a mixture of mainly hydrogen and nitrogen for use in a gas battery. When trying to remove the carbon monoxide, he came across that strange compound nickel carbonyl. Mond gas and Mond's nickel process evidently formed a sufficiently important industrial issue to make the inventor forget his original problem—a coal-fed gas battery. Is it worth while now, after the discoveries relating to ionising hydrogen by catalysers, to revive this research? Perhaps it is. Anyway, I shall try to analyse the *pros* and *cons* later on.

The more obvious way of using a carbon pole as dissolving element was tried by a number of inventors following Jablochoff's lead. That investigator tried a combination of retort carbon, sodium nitrate in a fused state, and iron. This method certainly yields an effect apparently depending upon the combustion of carbon, but it only forms the scientific curiosity mentioned in my opening sentence. The merit of the invention is, however, great, and will stand as the first positive attempt to solve a world's problem. What could be said about Edison's carbon, fused iron oxide and iron combination, which appeared, many years later, in 1893, was no doubt attended to by the Transatlantic daily Press. At about the same time Swan in this country tried fused chloride of lead as an electrolyte, with lead opposed to carbon, but the current went the wrong way, whether air was blown in or not, viz., the lead dissolved, yielding the E.M.F. Surrounding the carbon pole with an atmosphere of chlorine gave the correct combination, which yielded quite considerable currents—*vide* Phil. Trans., Roy. Soc., 1894, "Voltaic Combinations with Fused Electrolyte," by J. W. Swan. This was, of course, only a side issue, but of great interest, as showing how the unexpected happens. Swan made these experiments out of curiosity, as he knew full well that utilising shaped carbon as a dissolving pole was an economic absurdity.

The attraction of fused electrolytes lay in their exceedingly high conductivity and the small loss by interior resistance, which, however, was more than counterbalanced by the cost of keeping them in the fused state. This fact evidently influenced Borchers in 1894 to produce a combination with an aqueous solution, supposed to utilise the carbon monoxide of producer gas as dissolving pole. His various proposed cells caused a lively correspondence in the electrical Press, in which the writer partook—*Electrician*, February 26th, 1895—as the E.M.F. did not correspond to the combination heat $CO + O = CO_2 + Cal.$ The electrolyte chosen was an ammoniacal solution of cuprous chloride, which dissolves carbon monoxide, and the chemical phenomena were complicated in the extreme. I pointed out, *loc. cit.*, the impossibility for CO to replace hydrogen as a cathion and the lack of feasibility for it to enter into the electrolytic changes. So far no practical gas battery, without hydrogen as the positive element, is known, and even then only when the arrangement favours the ionising of the hydrogen. There, Mond's idea was undoubtedly the right one, and that of Borchers wrong. Anyway, the latter's effort led to no practical results.

Now, the first battery utilising the heat of combustion of hydrogen for developing an E.M.F. and capable of yielding a current was Grove's gas cell—some writers ascribe the discovery to Ritter, but Grove is probably more widely known in this connection. In this cell both oxygen and hydrogen are separately in treble contact with platinum, and an electrolyte, and the action depends entirely upon the "catalytic" or ionising effect of the platinum on the gases. As the acting contact surface is very small, these batteries produce very feeble effects. Modern research has shown that hydrogen ionises with remarkable ease, and that the work done during the process is exceedingly small. Important industries are based on the hydrogenisation of oils by ionising with finely divided metals suspended in the oil under treatment. It is highly interesting to note, in view of Mond's experiments, that finely divided nickel is an excellent catalyser for the purpose. On the negative side, the production of sulphuric acid by the contact process is another example, though unfortunately platinum seems to be indispensable for the purpose as well as defined conditions of temperature. Now, if we go on speculating, there is a definite way of storing these effects of ionised hydrogen and oxygen for immediate use as generators of electric current, viz., the storage battery. If we could continuously regenerate the plates of an accumulator by ionised hydrogen and oxygen, derived from coal and the air, there would be one solution of the coal problem. This idea has had a place in my mind—sometimes a prominent one—for a good number of years. Some time ago I went through my old copying books searching for something or another, and I accidentally came across a letter, dated November 11th, 1899, which not only put the question, but also proposed a method of answering it as our knowledge stood then, in a perfectly workable manner. For obvious reasons, I cannot publish the letter *in toto*, but I shall give some elucidating extracts:—

"There is, however, one feature in connection with this voltaic combination [the storage battery] which interested me many years ago, and on which I was preparing experiments at X, which might be entered upon with every probability of securing the solution of one of the most important problems of to-day, namely, the transforming of the potential energy of coals into electric current directly. The solution proposed would *à priori* be the following:

"On condition that the chemical reactions which attend the charging of an accumulator could be carried out cheaply by purely chemical means, we should be able to produce the same amount of energy in that way as by charging by means of engine and dynamo."

After discussing the positive pole at some length, the letter says in one place:

"On condition that we could by forcing a gas like hydrogen into the pores of spongy lead in such a manner as to make this gas oxidise instead of the lead itself, which may be feasible, as the spongy lead itself would generate the electromotive force necessary for the direct oxidation of hydrogen in a liquid, we should then have a means of transforming the heat of combustion of hydrogen into electric energy directly—or, in other words, to prevent the cathode reaction of a storage battery without impairing its power of output of current. Considering that water gas contains nearly 40 per cent. [by volume] of hydrogen, this cheap gas might be utilised for the production of current, on condition that the theory set forth above can be borne out by actual experiment." . . .

The hopelessness of expecting carbon monoxide to enter into the action is also pointed out. In view of modern discoveries relating to ionisation of hydrogen, we can see that the above reasoning is probably correct. Even at the period of the letter it was known that the larger part of the hydrogen in the pores of the negatives of a charged battery partook in the generation of current, though part undoubtedly came off by bubbling for a long time, if the circuit was left open. Practical issues can, however, be arrived at by experiment only. The great economical problem is, how much of the heat of combustion of coal might be obtained as electrical energy in this way. One would, of course, in the first instance remove volatile, valuable, products by carbonisation of the kind which shows the best balance sheet, and the rest would be made into producer gas of some sort. When aiming at a maximum of hydrogen contents, the loss as sensible heat is increased, but it is feasible to use it partially for preheating the carbonisers or to use it for the distillation plants, &c.

Here it may be of some use to try to estimate approximately what can be got out of a ton of coal by first removing volatile matter by high or low-temperature carbonisation, leaving a carbonaceous residue for the production of gas for direct conversion into electric energy or for burning directly or indirectly in boiler fires. From a number of investigations I may say that the carbon in the fixed products ranges somewhere about 60 per cent., the volatile matter round 35 per cent., and ash, say, 5 per cent. For a ton of coal this means:—Solid carbon, 12 cwt.; tar and gas, 7 cwt.; ash, 1 cwt. For high-temperature carbonisation the tar ranges round 12 per cent. of the weight of the original coal, and for the low-temperature process round 20 per cent. with a corresponding lower yield of gas. It may or it may not be that the old illuminating gas is doomed. Its fate does not affect the present subject, but tar and tar products are such an industrial necessity that carbonisation on a large scale will always be necessary. It follows that the direct transformation of the heat of combustion of the fixed carbon is not such a rose-coloured proposition compared with burning raw coal under boilers as at present. This latter process yields in good plants electric current with an efficiency round about 20 per cent. of theory. With a preliminary carbonisation only about one-half of the original heat of combustion remains available for conversion, and then there are the cost of producing gas, loss as live heat, and generating losses to be considered. Should, however, burning of raw coal be prohibited by law, which is only a question of time, then the old attractiveness of the problem under discussion would again come to the fore, but with some modification, based upon the impossibility of getting the full hydrogen equivalent of the carbon. The reaction:

$$C + 2H_2O = 4H + CO_2 + Cal.$$

is unfortunately not possible to anything like the full extent on account of thermo-chemical dissociation phenomena. To consider the production of hydrogen direct from raw coal is also not very promising, as the yield from the corresponding coke or coalite, or whatever you call it, is about the same, and the by-products cannot economically be wasted. For the moment this old idea of Jablochoff's must be considered somewhat hopeless in spite of our greater knowledge of the phenomena of ionisation, and in spite of suitable arrangements being thinkable.

There is another side of the question to be considered, viz., radiant heat being a kind of transversal vibration of the ether, could it not be transformed into higher frequencies? Is it so certain that some more efficient recipient than thermo-couples may not exist? In all arrangements known to us radiant heat reappears as heat, but as the wave length diminishes and the vibrations become luminous we see certain salts decompose into electrical opposites. Why do good conductors let both heat and electricity pass, but not light? Why do we get electrical induction and not heat induction? There must be some algebraical continuity in all these things; even such a low form of vibration as sound, which uses a coarser medium, causes induction in resonators, then comes a hiatus for heat, then light shows interference, and electricity resonance again. The fact is that a physicist of to-day gets more and more bewildered with regard to the complexity of matter and things material. It was all very well for Kant to preach about its continuity as being the only thing compatible with pure reason, but here we see one modern thinker after the other construct conceptions of various kinds of discontinuous matter to explain observed phenomena. Here in connection with the problem under discussion we lie beaten to the dust by the absence of knowledge of something which will give the higher harmonics of the heat vibrations. I will point out a peculiar thing about electricity, viz., we know electrical undulations of lower frequency than that of the lowest audible note, and others of a higher frequency than ultra-violet light; still they are all undoubtedly electrical and obliging, and the same medium is supposed to vibrate for them in the same way as for heat and light. It reminds me of a teacher in my schooldays, who taught Lutheran theology one hour and logic the next. During one hour he gave the accepted proofs of the existence of the Almighty, and during the next he proved that every one of them was illogical. It is always thus when we are short of facts. We know that heat ought to be "re-transformable" into vibrations of higher potentiality directly as well as by round-about ways, but we are minus the class of phenomenon to demonstrate the change. It may be the coalfields will be exhausted before we find the *leit motif*.

Since I started writing these notes the coal question has become acute in another direction. However disastrous these disturbances may be, they should set people thinking, whether unrestricted coal export is to the advantage of this country. Maybe a more economical use of coal inside the borders would be a more permanent blessing. The steps taken with regard to centralisation of electrical generating stations may involve some saving, but have we arrived at the highest possible efficiency of plant? I fear that the hydro-electric stations in America and elsewhere are not strictly commensurable with steam-driven plant, and that reports by travelling economists mislead the public. The limits of size of the most economical units are different, and the risks of high-tension distribution in a densely populated country like Great Britain seem to be given too little consideration. In this respect I think the best judges are the British engineers themselves, who have, in spite of stringent laws and excellent guardianship of public safety, made electric light at least the cheapest illuminant, even in many districts of London. They have to their credit almost everything related to the efficiency of electric direct-current generators, and they have evolved the kind of plant most suitable for this country. That they have neglected modern developments in alternating-current practice is not true, and the economical considerations for or against have no doubt been carefully considered. If the problem of direct production of electric current from coal should be solved, I feel certain it will be done here, and everybody knows that in no other country are heat engines and their economy occupying so many minds. The almost imperceptible adoption of higher steam pressures and smaller dimensions of engines in this country is not known and understood by the economists, neither do they appreciate the efforts of metallurgists to make still higher pressures and still smaller dimensions possible and safe. A lot has to be done in this line before 50,000-kilowatt units and the like can become the rule with steam plant on land, where a fraction of a penny on the Board of Trade unit tells.

I have tried in the above to point out the intrinsic difficulties of finding a new way to generate "power," as the popular term will have it, and that what we are really waiting for is some new discovery relating to radiant energy—or some lower form of it than heat. We are on the border of some sort of new departure in colloidal chemistry, where change of state of aggregation takes place apparently independently of quantity of the acting agent, which may cause the opposite effects with different colloids. "Flocculation" and "deflocculation" are mere words like

"sols" and "gels," and the absence of evolution of heat during the processes indicates some mysterious sort of energy, the nature of which we do not know. There is evidently a large amount of mechanical work done during most coagulation phenomena in the re-grouping of ponderable particles, but the dynamics of the whole thing is unknown. In organic chemistry the polymerisation of liquid or even gaseous aldehydes into hard solids is another puzzling thing dynamically. One of these things is rather extra-remarkable; the oil formed by treating phenols with formaldehyde solidifies by the application of heat. The product, known as Bakelite, and used as an insulating compound, supposed to come from the United States, was made in this country many years ago under the auspices of James Swinburne, and was, if I remember rightly, a German discovery. The solidification is caused by high temperature and not by evaporation of a solvent. Such apparent absurdities are quite common in organic chemistry, the physical side of which is almost a virgin field in many respects. We may expect startling discoveries, once the French cooking part of the business is less attractive as leading on to fortune. The essential difference between reactions in organic chemistry and those of inorganic nature is the lower velocity of the former, although there are startling exceptions. As a matter of fact, almost all our knowledge of reaction velocities is based upon interaction between inorganic and organic compounds like estherification, inversion of cane sugar, &c., as these are slow enough to allow mensuration of time as well as of effect in the case of homogeneous systems. The clearness of understanding is, however, vitiated by numerical constants, depending upon the nature of the organic compounds in question. Reactions between inorganic compounds in a homogeneous system are too swift for mensuration, and there we have to fall back on heterogeneous systems, like metals and acids, which form the basis of the modern theory of electrolysis, and which we know with a fair amount of mathematical certainty with regard to energy forms and quantities. In homogeneous solid systems, both inorganic and organic, changes sometimes take place, which require years and even centuries to be completed. All engineers are acquainted with the after-hardening of cement and the grain-growth of metals. An imitation of both can be obtained by application of heat as in the Le Chatelier test for cement and the annealing of metals. What is the active force during the ordinary slow, relentless action? We can exclude chemical action by the atmosphere or water as having anything to do with the case, although I do not think anybody has tried storing in vacuo. If it is the evening-out of internal stresses, why does cohesion in one case increase and in the other decrease? Or, again, is it a lower form of heat or energy of exceedingly low potential, which takes its time about it? I admit that, in the case of metals, vibration or alternate stresses within the elastic limit enhance the effect, and that "intra-crystalline" gliding and sliding does take place, but what causes it to start during a state of rest? Is it, after all, possible that an iso-thermal change can do external work of sufficient magnitude to affect the intra-molecular forces of steel?

Meta-physical speculation does not help us much; it is more likely to open the doors of a certain well-known institution in North London to its victims. We want experimental facts. But as long as cement experts keep on juggling with a pair of trowels, and metallurgists keep on grinding and polishing for one kind of purpose only, we are not likely to see much headway in explaining the phenomena of slow changes. We are apt to take modern thermo-dynamics as gospel and heat as the last state of dissipation of energy, although there may be many other stages before the final cardiac syncope. Even ordinary temperatures have a great potentiality, as we see every spring before our eyes, and vital phenomena are highly efficient. Hence it seems somewhat humiliating that we cannot get more out of heat at the temperature of burning coal. In spite of the bulkiness of a modern scientific library, we know very little indeed about the inner workings of Nature. We know some facts as stray facts only, like the power of the electric eel and the electrification of crystals, like tourmaline, through heat. How does the former insulate the high-tension stresses? With regard to tourmaline, this is the information given in an otherwise rather elaborate book on mineralogy: "It becomes by friction positively electrical, by heating electrically *polarised*." Now supposing we could by uniting the poles by a conductor keep up a current—however minute—by continued heating, we should have a direct transformation of heat into electric energy—a *leit motif*. It never struck me to try, when I analysed a specimen as a student, that there may be some practical issue indicated by this thermo-electric polarisation, and I suppose I was only one out of a good many. As a matter of fact, the idea came when searching my mind for "matter," whilst writing—correctly interpreted, there is no contradiction intended; the joke was not preconceived.

Finally, I will give the same advice to investigators as Berzelius did, in his last speech of any note, in 1842. His words fell something like this: "Let us all patiently search Nature, she always gives an answer if we search long enough. Do not let us make Icarus wings of theory, a thing altogether too common in these days. The rays of the sun of truth will sooner or later melt the wax and the wings will collapse." Such were the words of that great investigator then, and maybe they are still more true to-day. Nature is humanly inexhaustible; maybe we shall one day solve the great problem discussed. Philosophical thinking has also its uses, but we must bear in mind the words of Thorild, engraved in black marble over the entrance to the aula of Upsala University: "To think free from restraint by custom is great; to think correctly is greater."

The Timbering of Trenches, Shafts and Tunnels.

By C. G. KENT, A.M. Inst. C.E.

NO. II.*

TUNNELS.

TUNNELS are driven either from shafts or the ends of trenches, and in either case the first step to be taken is to remove the struts or walings which may cross the driving face. This is done by soldiering with any additional strutting necessary, as previously described. The tunnels, the timbering of which will now be described, vary in size from a small box heading to a large one of circular section.

Box Heading in Bad Ground.—It is proposed to describe first the method by which a box heading in moderately bad ground is timbered. After the removal from the driving face of such timbers as may be necessary and the temporary supporting of the boards or runners which may have been held by these timbers, a frame consisting of head tree, side trees and sill of the size necessary for the heading, is fixed against the driving face, and piling boards are driven in above and at the sides of the frame, portions of the boards or runners of the trench or shaft having been cut away to admit of this—Fig. 19. When the head boards and as many of the side boards as may be necessary have been driven rather more than half their length—the excavation of the upper portion of the heading proceeding simultaneously—the leading ends of the head boards are supported on legs resting on a benching, and a temporary or intermediate head tree is placed in position with short side trees off the benching—as in Fig. 20. This serves as a guide for the further driving of the boards and also reduces the unsupported length of the latter. The central lower portion of the heading is then excavated, triangular benches being left to support the short side trees and a centre prop, the full depth of the heading, is inserted under the head tree. The benchings are then removed, the lower side boards being driven forward simultaneosuly, and two side trees—in place of the short ones—are put in resting on a sill. The face during these operations is cross poled or vertically piled as may be necessary. The heading has then reached the stage shown in Fig. 21.

The operations already described are then repeated and the boards driven to their full length. Before fixing the next frame, liner boards are nailed against the piling boards and chogs inserted between them and the frame to give board and wedge room for the next setting—see Fig. 19. A cross section of the complete heading is shown in Fig. 22.

If the ground is not too bad, the frame near the middle of the setting can be removed later, but if the

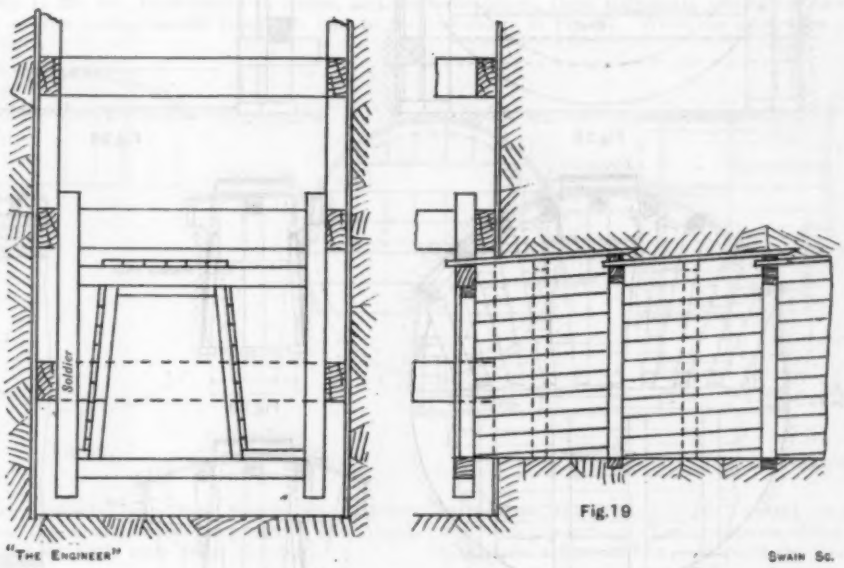


Fig.19

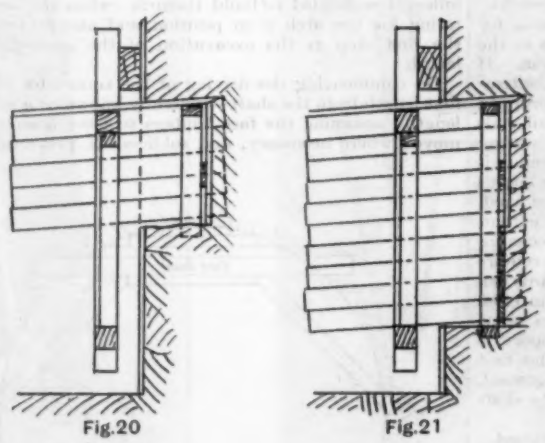


Fig.20

Fig.21

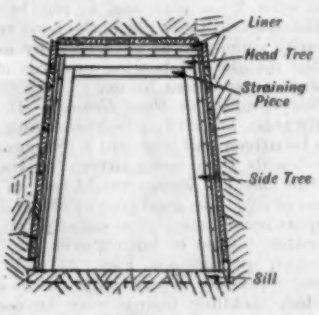


Fig.22

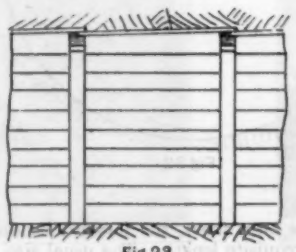


Fig.23

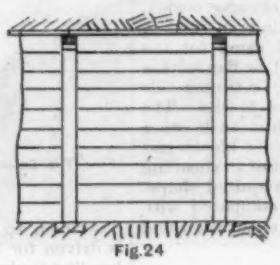


Fig.24

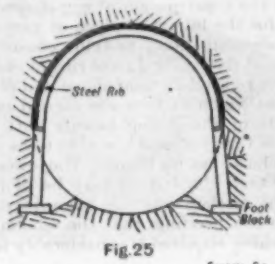


Fig.25

"THE ENGINEER" SWAIN SC.

* No. I. appeared July 16th.

pressure of the ground necessitates, it is left in and is known as an intermediate frame. The next setting is piled as previously described.

Should the bottom of the heading be very soft, boards should be placed under the sills to give adequate bearing, and in the extreme case when the ground is forced up by the side pressure it may be necessary to pile under the sills. If the benching is so unstable as to be incapable of preventing the settlement of the head tree during the excavation for the centre prop, it is necessary to fix walings in the form of a V on plan and to pile behind them. If settlement still takes place, the head tree can be temporarily supported at both ends by needles propped in the middle and bearing upwards at the tail ends against a convenient frame.

Box Heading in Good Ground.—If the ground is fairly good, but still necessitates piling, all the boards can be driven half way and a temporary frame fixed, the boards then being driven to their full extent. In this case the frames would rest on foot blocks instead of sills. In good ground which does not require support immediately after excavation, the boards can be either tucked or butted over the frames in close or open poling—see Figs. 23 and 24. In some cases, especially where only occasional support is needed, middling boards may be used. The first frame put in when starting a heading in good ground, may be fixed inside the heading instead of in the shaft as described for bad ground.

Heading with Semi-circular Top in Good Ground—Fig. 25.—An excellent method of driving a heading for the construction of egg-shaped or circular sewers, or for the laying of pipes of various kinds in good or moderately good ground, consists of using for the top of the heading steel ribs of either T or flat section bent to semi-circular shape and resting on timber side trees which in turn are carried on foot blocks. The ends of the poling boards butt against each other over the ribs, and the side trees and foot blocks rest in chases cut for them. The lower part of the heading between the frames may be of any required shape. This method has the advantage, as compared with the box heading, that the amount of excavation and packing required is considerably less.

TIMBERING FOR LARGE CIRCULAR TUNNELS.

(i.) *In Moderate Ground.*—The methods of timbering now to be described are applicable to brick, masonry or concrete tunnels, the external diameters of which range from about 7ft. to 18ft. The work is put in in sections, known as lengths, of from 9ft. to 12ft., the building of each being commenced as soon as the excavation for it is completed. In all cases a forward heading, the top of which is somewhat higher than the crown of the finished work, is maintained ahead of the length in hand for a distance a few feet greater than the length of a section of brickwork, the objects being to provide a means whereby the bars used for supporting the top of the tunnel may be removed—

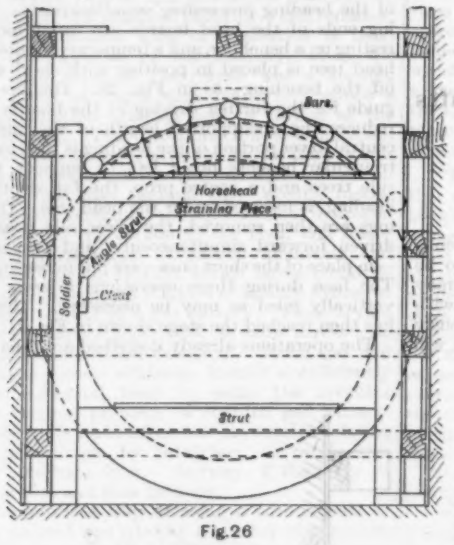
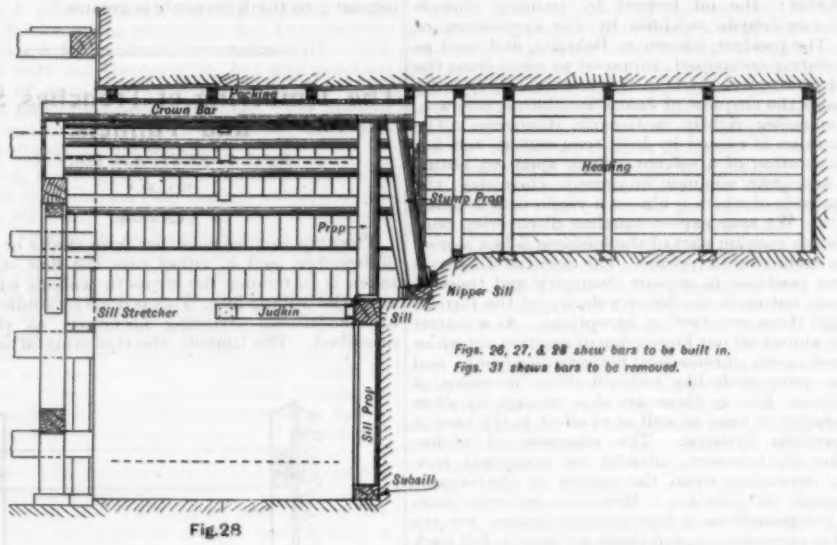


Fig.26



Figs. 26, 27, & 28 shew bars to be built in.
Figs. 31 shows bars to be removed.
Fig.28

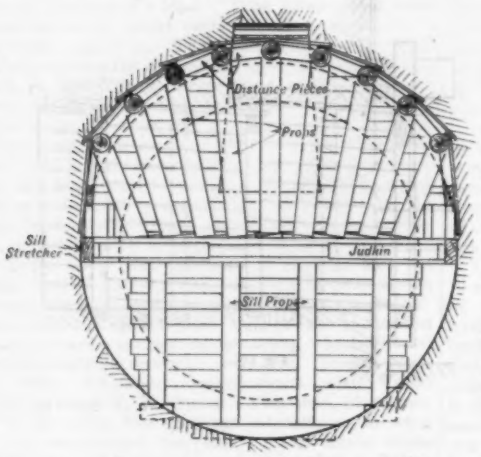


Fig.27

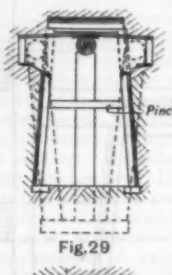


Fig.29

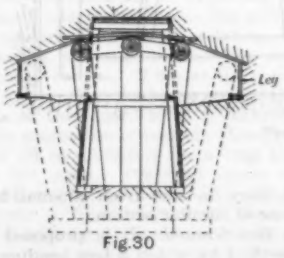


Fig.30

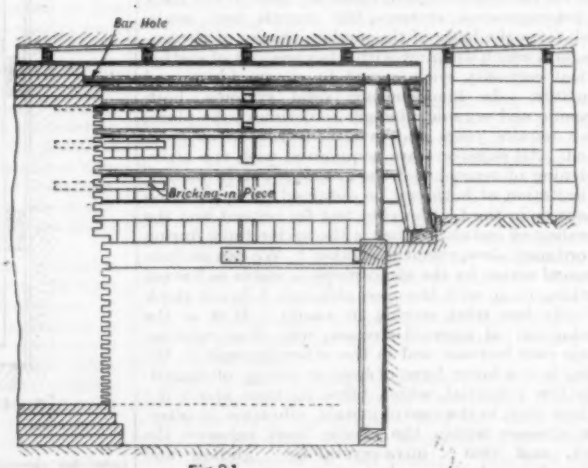


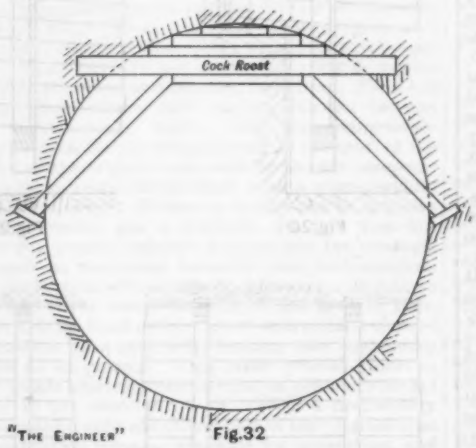
Fig.31

"THE ENGINEER" SWAIN Sc.

unless it is decided to build them in—when the centering for the arch is in position, and also to form the first step in the excavation of the succeeding length.

On commencing the driving of the tunnel for the first length from the shaft—generally known as a side length—assuming the face timbers to have been removed where necessary, and soldiers, as previously described, to have been fixed, the forward heading is driven for the requisite length. The usual size of heading is about 6ft. high by 3ft. wide at the top and 4ft. at the bottom. The method of timbering the heading is as previously described.

A horizontal timber, known as a horsehead, is fixed between the soldiers, as shown in Fig. 26. This acts, in addition, as one of the soldier struts. A crown bar, extending to about 3ft. beyond the leading end of the brick length, is then fixed in the heading with its top slightly below the straining pieces of the heading frames, one end being propped from the horsehead and the other resting on a prop called a stump prop, the foot of which is carried on a nipper sill about 3ft. 6in. long, placed on or slightly below the bottom of the heading—see Figs. 27 and 28. The stump prop leans towards the shaft to prevent any forward movement of the bar. The levels of the top of the forward heading and bars in relation to that of the finished work depend upon whether it is intended to remove the bars or build them in. In the former case the bars may be within the limits of the work, but in the latter they must be clear of the extrados of the arch. In side lengths, bars are frequently built in as a precautionary measure, and sometimes two bars, one on each side of the centre, are used instead of the crown bar described.



"THE ENGINEER" Fig.32

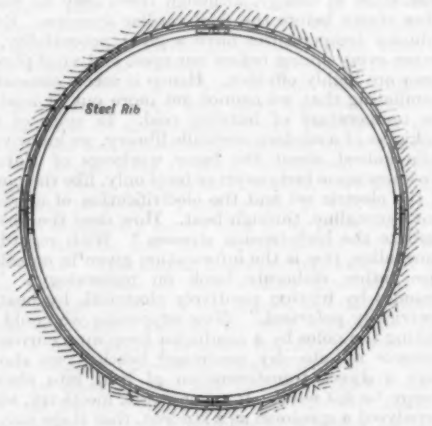
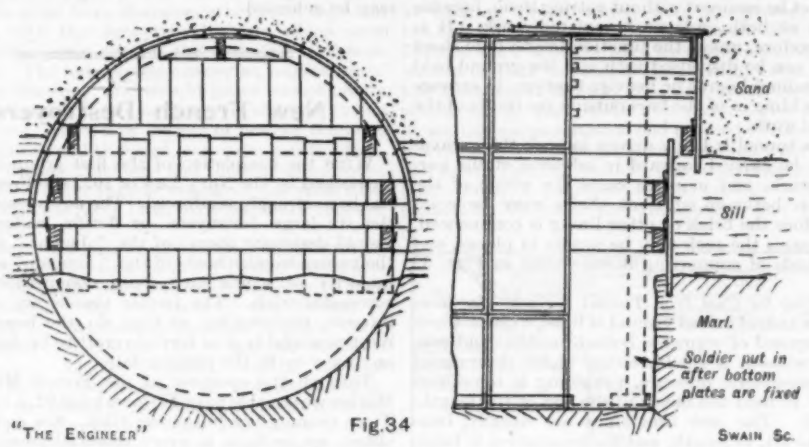


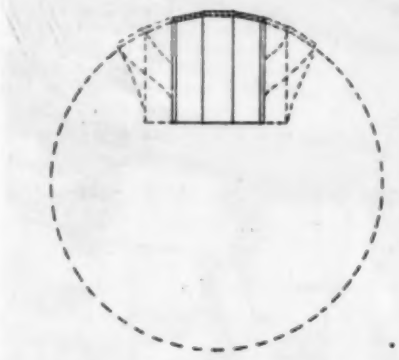
Fig.33 SWAIN Sc.

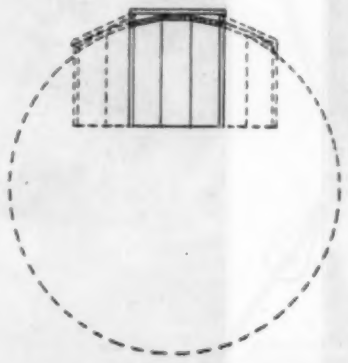
The next step is to fix the second and third bars—generally called the two-third bars—and in order to effect this the top of the forward heading for the required length must be widened out, as shown in Fig. 29. Pincher struts are usually inserted between the side trees of the heading frames, so as to enable the tops of the side trees to be cut off, the head trees

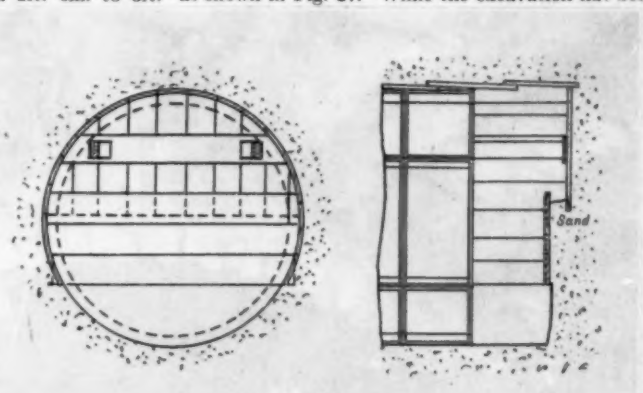
and head boards being held by the crown bar, and the former being wedged off it. The top side boards of the heading are removed and the necessary excavation done to enable poling boards to be fixed with one



end bearing on the crown bar and the other on bricks or short legs resting on the benching formed. This having been done, the two bars are placed in







position and propped, as in the case of the crown bar, at one end from the horsehead and at the other from the nipper sill. The props at both ends are fixed with the tops further apart than the lower ends, those at the leading end having a rake, as in the case of the prop under the crown bar. The feet of the props are chogged from the centre props. In order to make room for the props at the leading end, chases are cut at the sides of the heading, and, as soon as the props have been fixed, horizontal boards are placed behind them to retain the face at the sides of the forward heading. The usual distance apart of the bars is from 2ft. to 2ft. 6in. from centre to centre, and the length of the poling boards from 2ft. 6in. to 3ft. The bars usually have liner boards above them, so that the boards may be tucked. The boards are paged at both ends from the bars.

Further settings and bars are then fixed in a similar manner, to the number required—see Figs. 29 and 30. The number depends upon the size of the tunnel and the extent to which the top requires support. The stump props for all bars after the third rest on foot-blocks, and the feet are all chogged apart. Unless the bars are to be built in, each bar after the third must be somewhat shorter than the bar previously put in, so that, on removal, the leading end can be passed in front of the stump prop under the adjacent bar.

The excavation has now reached sill level, and the next operation is to fix a sill, about a foot in front of the nipper sill, extending the full width of the tunnel. Props are then fixed between the sill and each bar, the props being vertical when viewed from the side, but having the same rake, when looked at from the front, as the corresponding stump props. The sill is prevented from moving forward or tilting by sill stretchers, shown in Fig. 28. In some cases angle struts, called judkins, are fixed, as shown, between the sill and the sill stretchers.

The excavation of the lower portion of the tunnel is now proceeded with, and the middle portion in front of the sill is removed first, in order that a subsill may be fixed under the sill near the bottom of the tunnel, while there are still benchings left under the sill at the ends. Sill props are fixed between the sill and the subsill, the sill being temporarily supported, if necessary, while this is done, by raking ground props. Poling boards may be needed below the sill, and these are fixed either as the excavation proceeds or after the sill props are in position. If necessary, additional sill props are fixed as the excavation nears completion, these frequently resting on foot blocks, as shown in Fig. 27. While the excavation has been in progress, the driving of the forward heading has also been proceeding. The usual sizes of the timbers mentioned are as follows:—Horseheads, 9in. by 9in. to 12in. by 12in.; bars, either round from 7in. to 10in. diameter, or square, with the corners usually chamfered off, 8in. to 10in. sides; occasionally R.S.J.'s about 8in. by 4in. are used as bars; props,

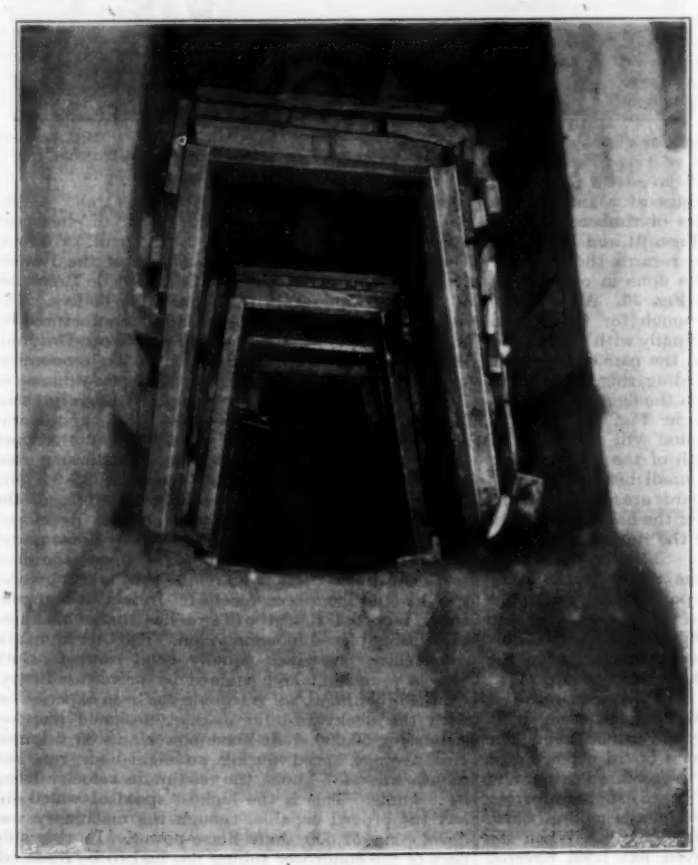


FIG. 28—FORWARD HEADING

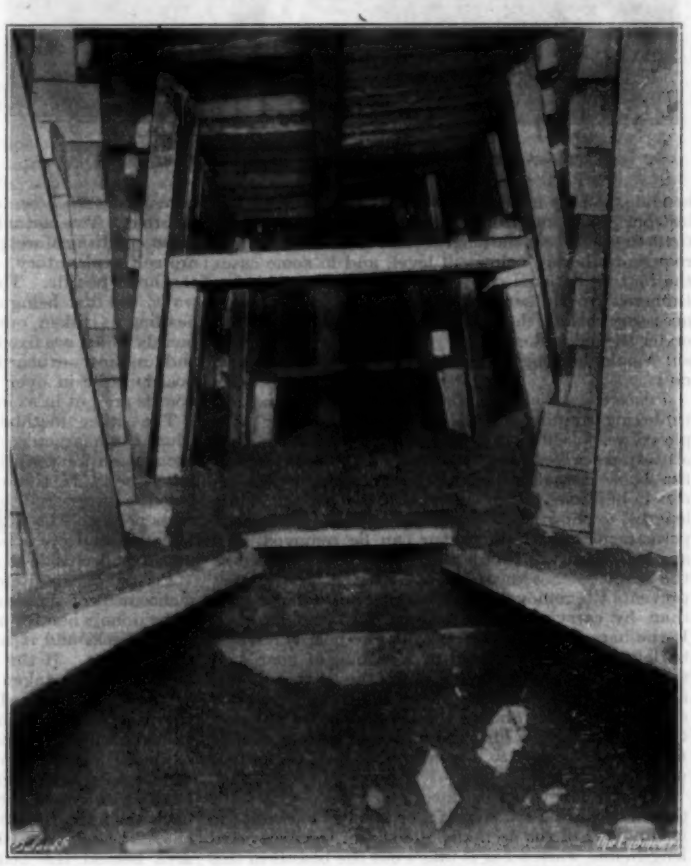


FIG. 30—CROWN BAR FIXED, POLING FOR THIRD BARS PROCEEDING

round, from 6in. to 8in. diameter; sills, 9in. by 9in. to 12in. by 12in.; sill props, 6in. by 6in. to 9in. by 9in.; sill stretchers, 6in. by 6in. to 12in. by 6in.; and subsills, 10in. by 5in. to 12in. by 6in.

The actual work of widening out the forward heading to the required dimensions is shown in Figs. 38 and 39, and in our Supplement.

(ii.) *In Good Ground.*—In this case the following modifications may be introduced into the method described :—

The frames and boards of the forward heading, if any, may be entirely removed before widening out for bars.

Fewer bars and open poling may be used.

Timbering below sill level may be dispensed with.

Lengths in sound rock may, of course, be excavated without any timbering.

(iii.) *In Bad Ground.*—In the case of really bad ground the following additional precautions are needed :—The "lengths" are usually shorter than in better ground, about 7ft. 6in. being the minimum. The face behind the stump props must be closely piled. Bars must extend round the whole of the upper part of the tunnel, and heavier bars may be needed or the bars may be spaced at shorter distances apart. In order to reduce the area of the ground exposed during excavating for a setting of boards, the tedious process known as cross piling may have to be resorted to. This consists of driving a small heading, usually in the middle of the length under the last bar put in and from this piling out in both directions to the ends of the length. The sides of the tunnel require timbering below sill level, and in some cases the bottom is taken out square, the lower half being timbered in the same way as a trench. Piling is necessary below the sill. Back props are required under the sill and extra sill props are used. The subsill should be long enough for all the props to rest on it.

Timbering Running Lengths.—The method of timbering running lengths, or those following completed work, differs in only one respect from that already described, and that is that the rear ends of the bars, instead of being carried on a horsehead, rest in bar holes left in the arch of the last completed length—as shown in Figs. 31 and 40. In building the permanent work, if all timber can be removed, bars and the settings of boards above them are taken out as the work reaches them. The centering for the arch prevents the removal of the bars by any other means than by carrying them forward into the heading. If the bars can be taken out, but the boards have to be left in, the building in of a setting of boards, if they are properly tucked, secures the setting above, and the bar immediately above the completed work can be removed. Should the boards not be properly tucked, however, a liner may have to be temporarily fixed above the bar to be removed to hold the boards until secured.

When a length of brickwork or masonry is built there is always a space of 2ft. or 3ft. left between the leading end of the arch and the end of the excavated length, and when a bar is taken out the boards in this space would fall out if steps were not taken to prevent them. The method adopted is to build behind the work overhanging pieces of timber known as bricking-in pieces—see Figs. 31 and 41—which, acting as cantilevers, support the boards referred to. If bars are built in for a series of lengths one and two crown bars are used alternately, and the rear ends of the bars of any length rest on the completed work between the leading ends of the bars built in over the preceding length.

In the case of a junction length, *i.e.*, a length joining two sections of a tunnel driven in opposite directions, bars cannot be removed without cutting them, because they rest at both ends on completed work. It is usual, therefore, unless the junction length is so short that bars can be dispensed with and the ground held by longitudinal boards or heavier timbers, to arrange for the building in of the bars outside the limits of the completed work.

When a tunnel is being driven in rock the excavation may be carried forward in advance of the permanent work, and in some cases the whole of the excavation between adjacent shafts may be completed before the brick or other lining is commenced. In these cases the rock may be unsafe in places, and two methods of supporting it are shown in Figs. 32 and 33.

Timbering for Cast Iron Tunnel Lining.—In cases in which a tunnel in bad ground is lined with cast iron rings composed of segments bolted together and constructed without a shield, either under compressed air or atmospheric pressure, timbering is sometimes necessary to hold the face and the top of the lengths excavated. The cast iron rings are usually from 1ft. 8in. to 2ft. in length, and the excavation is taken out for single rings, where the ground is so bad as to necessitate this, or for two rings at a time where possible. Two actual examples of timbering under these conditions are given in Figs. 34 and 37, which are self-explanatory, except as regards the fixing of the head boards. This may be done in one of two ways, the first being shown in Fig. 35. A small top heading is taken out wide enough for three head boards which are fixed longitudinally with the leading ends resting on board legs and the rear ends on the boards built in over the preceding ring. The next boards are put in as indicated in the figure.

The other method—shown in Fig. 36—is used when the character of the ground will not admit of excavation for the whole length of the boards being taken out. In this case the small heading is cross poled as shown, and the head boards are fixed under the cross poling. The side boards of the heading are then removed and cross poling for the next head boards put in on each side as shown.

Poling Back.—Reference was made at the commencement of these articles to poling back, which has to be done when for any reason poling boards have to be set back, and it is now proposed to describe how this is done. If the ground is sufficiently good the boards may be taken out, either singly or several at a time, and replaced in the required position after the necessary additional excavation has been done. In bad ground cross poling may have to be used. The method consists of cutting out a board a piece at a time, raking out the ground to the required extent and putting in a small horizontal board, slightly further back than the required position of the poling board, chogged back from the adjacent boards. When the area behind the board removed has been covered with cross poling another board can be put in in the required position in front of the cross poling. The next board is then removed in the same way, and in this case the cross poling will be fixed at one end behind the cross poling previously put in and chogged at the other end behind the next board.

It should be stated that, although an endeavour has been made to describe most of the methods used in the timbering of trenches, shafts and tunnels, the examples given should be taken as typical only, as the work admits of many modifications, and there is frequently a choice of means by which a given object may be achieved.

FIG. 40—METHOD OF SUPPORTING REAR ENDS OF BARS

FIG. 41—BRICKING-IN PIECES

New French Destroyers.

WITH the completion of the first group of vessels authorised by the Navy Law of 1922 the French Navy has been strongly reinforced. The new vessels include the six large destroyers—or flotilla leaders, as we should designate them—of the "Jaguar" class, and the twelve smaller boats of the "Simoun" series, the majority of which have been commissioned after successful trials. The former vessels are of special interest, representing as they do the heaviest and most powerful type of torpedo craft to be designed for any navy up to the present date.

Through the courtesy of the French Ministry of Marine we are able to publish, on page 92, a view of the Tigre running her full-power trial. She and her five sisters are uniform in every essential particular, the leading details being as follows :—Length between perpendiculars, 392¾ft.; length over all, 416ft.; breadth, 36ft.; normal draught, 14¾ft.; displacement at normal draught, 2359 tons; at full load, 2870 tons. The Tigre is equipped with turbines of the Rateau type, made by the Ateliers et Chantiers de Bretagne, of Nantes. There are five small-tube boilers. The reduction gearing was designed and manufactured by the Power Plant Company, Ltd., of West Drayton, Middlesex. The radius of action at an economical speed of 15 knots is 3500 knots. The performance of the Tigre on trial was considered to be very satisfactory. A maximum speed of 36·7 knots was attained, the vessel continuing to travel at that pace for 1½ hours. During an eight-hour endurance run, in indifferent weather, a mean speed of 35·9 knots was recorded, that being 0·4 knot in excess of the designed maximum speed. The boilers developed considerably more than the 50,000 horse-power specified, and had a full head of steam been admitted to the turbines there is no doubt that a still greater speed would have been reached. In fact, it is unofficially reported that the Tigre has made 37 knots since being placed in commission. The Chacal, of the same class, has given equally good results. Both vessels were built and engined by private industry. On the other hand, some trouble has been experienced with the dockyard-built Jaguar, designed like her sisters for 50,000 shaft horse-power and 35·5 knots. Her average speed during an eight-hour run last month was 34·5 knots, the maximum velocity being 34·8 knots. This is the highest speed of which she has yet proved capable, though the machinery was developing 52,500 shaft horse-power. In this ship part of the condenser tubing has had to be replaced.

The general appearance of the "Jaguar" class and the disposition of the armament are clearly shown in our illustration. Each vessel is armed with five 5·1in. guns on the centre line, two 2·9in. A.A. guns, and six 21·7in. torpedo tubes on triple mountings. The 5·1in. is a new mark in the French service. It appears to be a short weapon, probably not more

than 40-calibre at most. The projectile weighs 27 kilos. (59½ lb.), or 33 kilos. with a special cap. The blast screens below the superposed guns at bow and stern seem rather inadequate as a protection for the crews of the deck guns when end-on firing is in progress. The ships have characteristic funnel tops and are fitted with the light tripod masts which were adopted some years ago for the majority of French destroyers. The new vessels convey an impression of power and efficiency, and should prove exceptionally useful for Mediterranean service. In addition to the six "Jaguars," three new leaders of heavier tonnage, the Lion, Bison, and Guépard, are under construction. They will displace 2500 tons and the stipulated speed is 36 knots. Twelve further vessels of the same class are included in the Navy Law, to be laid down between 1926 and 1929.

The Simoun, of which we also publish an illustration on page 92, belongs to a series of twelve destroyers laid down in 1923, most of which have now gone into commission. She was built by the Ateliers et Chantiers de St. Nazaire and launched in June, 1924. Her principal dimensions are:—Length between perpendiculars, 326ft.; breadth, 31¼ft.; normal draught, 12¼ft.; displacement at normal draught, 1434 tons; at full load, 1475 tons. She has turbines with reduction gearing and three small-tube boilers, the designed output being 33,000 shaft horse-power for 33 knots. With the maximum supply of 350 tons of oil fuel on board the steaming radius is 3000 knots at economical speed, viz., 15 knots. The armament consists of four 5·1in. guns, one 2·9in. A.A. gun, and six torpedo tubes of 21·7in. bore. Ten other destroyers of 1471 to 1495 tons are now being built. The Simoun and her sister boats have turned out to be successful steamers, the designed speed having been exceeded in most units of the class. The lofty freeboard forward makes them excellent sea boats.

London Electric Railways: Extensions.

No. I.

THE CHARING CROSS AND KENNINGTON.

A FACT, to-day forgotten by many, is that, though now part of the common system of the London Electric Railways, the Baker-street and Waterloo Railway and the Charing Cross, Euston and Hampstead Railway were originally separate concerns. The former line was opened between Baker-street and Kennington-road (now Lambeth, North) on March 10th, 1906, and extended to its then and present southern terminus at Elephant and Castle on August 5th following. Its northern extensions have been:—To Marylebone, March 27th, 1907; to Edgware-road, June 23rd, 1907; to Paddington, December 1st, 1913; to Queen's Park, January 10th, 1915; and over the London and North-Western to Willesden, on May 10th, 1915; and by the same company's system to Watford, on April 16th, 1917.

The Charing Cross, Euston and Hampstead Railway was opened between the station at Charing Cross—that is now known as Strand—and Golders Green, with a branch from Camden Town to Highgate, on June 23rd, 1907; it was carried southwards to the Embankment and the present Charing Cross Station on April 6th, 1914; was extended from Golders Green to Hendon on November 19th, 1923; made a junction with the City and South London at Euston on April 20th, 1924; and was further extended northwards to Edgware on August 18th, 1924.

In the series of articles, of which this is the first, mention will be made of another line—the City and South London. It was the pioneer of the present tube railways, not only in this country, but in the world. The original termini were King William-street and Stockwell, between which points the line was opened on December 18th, 1890. On February 25th, 1900, it was extended northwards to Moorgate, and on July 1st of the same year southwards to Clapham Common. From Moorgate it was taken to the Angel on November 17th, 1901, and to Euston on April 11th, 1907.

Having said so much we may as well complete the history of the tube railways in London and say that the Waterloo and City was opened on August 8th, 1898, and the Central London, as between the Bank and Shepherd's Bush, on July 3rd, 1900. The latter was extended to Wood-lane in a westwardly direction on May 14th, 1908, and eastwardly from the Bank to Liverpool-street on July 27th, 1912. The Great Northern and City was brought into service on February 13th, 1904, and the Great Northern, Piccadilly and Brompton on December 15th, 1906. The branch of the latter from Holborn to Strand—now Aldwych—was opened on November 30th, 1907.

Reverting now to the Baker-street and Waterloo and the Charing Cross, Euston and Hampstead railways, it will be remembered that whilst the former had an under-the-river section and thus served both sides of the Thames, the Hampstead line was wholly on the Middlesex side and ended on the north side of the river. Passengers to and from the south side, which number about four millions a year, have had to change and use the Baker-street and Waterloo line. Among those who had to change were the numerous passengers to and from Waterloo.

The extensions of these two systems—the one to Willesden and Watford and the other to Hendon and Edgware—greatly taxed the capacity of both stations at Charing Cross, which were interchange points, not only for these two lines, but for the Metropolitan District also. Powers were therefore obtained in the session of 1923 to extend the Charing Cross, Euston and Hampstead Railway by a line, as shown in Fig. 1, which was to pass under the river, serve Waterloo by an independent station and proceed to Kennington, where there was to be a common station with the City and South London Railway and a junction with that line. Such a junction would provide a physical connection between the Hampstead and the City

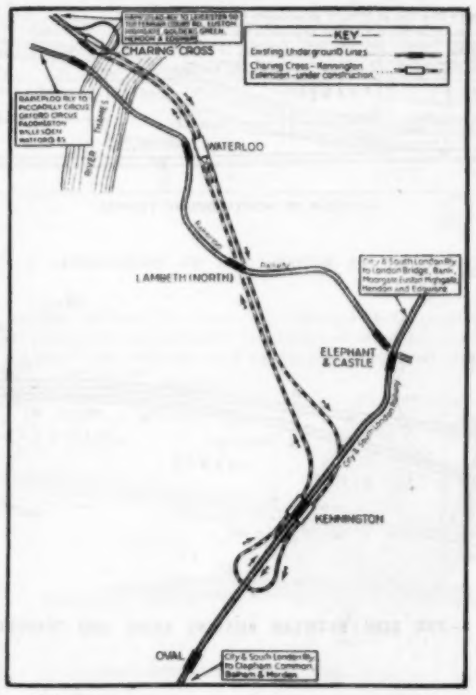


FIG. 1—THE CHARING CROSS - KENNINGTON EXTENSION

and South London lines. That feature was of all the greater importance because of the extension of the latter railway from Clapham Common to Morden, sanctioned during the same session and referred to later. As soon as the Royal Assent had been given the plans for the work were prepared by Mr. Harley H. Dalrymple-Hay, the consulting engineer to the London Electric Railways Company, and the contract was let to the Metropolitan Tunnel and Public Works Company, Ltd.

It is necessary in the description of the works we are enabled to give by Mr. Dalrymple-Hay's courtesy to mention at the outset that the Hampstead line—as it is called for brevity—terminated at Charing Cross by a circular loop. Arriving trains, on leaving Strand Station, passed round the loop—and thus reversed their direction from south to north—to the station which was on the west side of the loop and practically tangential to what was then the north-bound line. All trains, though they had come from the Euston direction, were north bound when they arrived at Charing Cross platform. With the Hampstead line continued in a southwards direction the necessity for the loop went. It might have been useful at times for reversing trains, but its retention was impracticable in view of the fact that the new south-bound line cuts through it.

The elimination of the loop at once presented the difficulty of getting trains from the Euston direction into the station. That was met by making the changes shown in the sketch Fig. 2. The south-bound line was broken off at the south end of Strand Station and buffer stops provided. The south-bound station at Strand was reserved for trains from Highgate, which did not go further, but were reversed there and went out again through the existing cross-over road at the north end of the station and what was the north-bound line became a temporary either-direction line. The cross-over road at Strand was converted into a scissors crossing—as it used to be in June, 1907, when the line was opened, until Strand ceased to be a terminus station in April, 1914—and allowed south-bound trains to pass through and to reach Charing Cross over what was, and again will be, the north-bound line, but which, during reconstruction, is used for both north-bound and south-bound trains. Only the Golders Green and Edgware trains use that line and they are reversed at Charing Cross and go out again over the same line. The single line working thus involved is wholly in the hands of the signalman at Strand signal-box, where all movements are controlled by track circuits. There are 216 trains a day over this length of single line and during the peak of the traffic there are twelve eight-car trains. An extra motorman is employed who, when a south-bound train enters the Strand Station, boards the rear motor cab, riding as a passenger. On arrival at Charing Cross the driver of the train places his control in the neutral position and signals to the extra motorman in the rear cab, who then cuts his control in and drives the train away to its destination. The driver who was in charge travels as a passenger to the Strand.

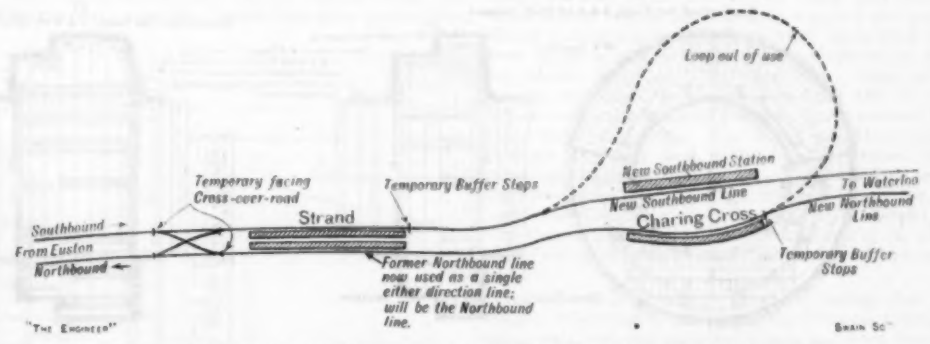


FIG. 2—TEMPORARY RE-ARRANGEMENT OF STRAND AND CHARING CROSS STATIONS

The plan reproduced in Fig. 3 shows the line from Charing Cross, under the river and to Waterloo Station. The new south-bound line leaves what was the circular loop under a point about half-way down Villiers-street. From that point to the north side of the river is 620ft., and therein an independent south-bound station has been built—the original station on the west side of the loop is to be the north-bound station. A shaft was sunk in the Embankment Gardens near the Water Gate at the foot of Buckingham-street, and there a shield chamber 25ft. diameter was built.

It may here be remarked that the internal diameter of the ordinary tunnel is 11ft. 8¼in. and the external diameter 12ft. 6in. On curves the internal dimensions are either 12ft. or 12ft. 6in., the corresponding external dimensions being 12ft. 9¾in. and 13ft. 3¾in., in stations the internal and external dimensions are 21ft. 2¾in. and 22ft. 6in. respectively. Where junctions have to be made the dimensions are increased by step-plate sections from 12ft. 6in. to 27ft.

Reverting to the construction of the south-bound station at Charing Cross, it is important to remark that it is situated in a position calling for great care. Above it are the Metropolitan District Railway and the Victoria Embankment, whilst near by are the river, the Charing Cross Station and bridge of the Southern Railway, and, west of the latter, the Baker-street and Waterloo Railway. In view of the delicate nature of the work, the shield chamber for driving the station tunnel was built by instalments. As shown in Fig. 4, rings of a 14ft. pilot tunnel—a length of 25ft.—were first excavated for and built. By breaking out from that, two temporary lengths, 1*a*, 2*a*, of 21ft. 2¾in. tunnel, were constructed, and they led up to rings 3, 4, 5, 6, 7 and 8 of the 25ft. shield chamber. The two temporary rings were then replaced by permanent 25ft. rings 1 and 2, and in the completed chamber the shield was built.

The advantage of that method of construction was that the excavation for the final size was gradually approached, and only a small face of ground exposed at a time. Further, as shown in the two drawings B, and in the side elevation F, the whole of the rings 3, 4 and part of ring 5 and of the permanent ring 2, have their top and sides permanently supported by 4ft. 6in. lengths of 56 lb. steel rails, built in behind the rings.

A further requirement in the work at that point arose out of the fact that the crown of the shield chamber encroached about 5ft. into the ballast. Ordinarily, that would have had to be cut into, but the undesirability of doing that to such an extent was partly removed by excavating the chamber at a lower depth than usual, so that the crown only penetrated into the ballast about 3ft. The shield was built at a correspondingly lower level, and, when

LONDON ELECTRIC RAILWAYS—CHARING CROSS AND KENNINGTON EXTENSION

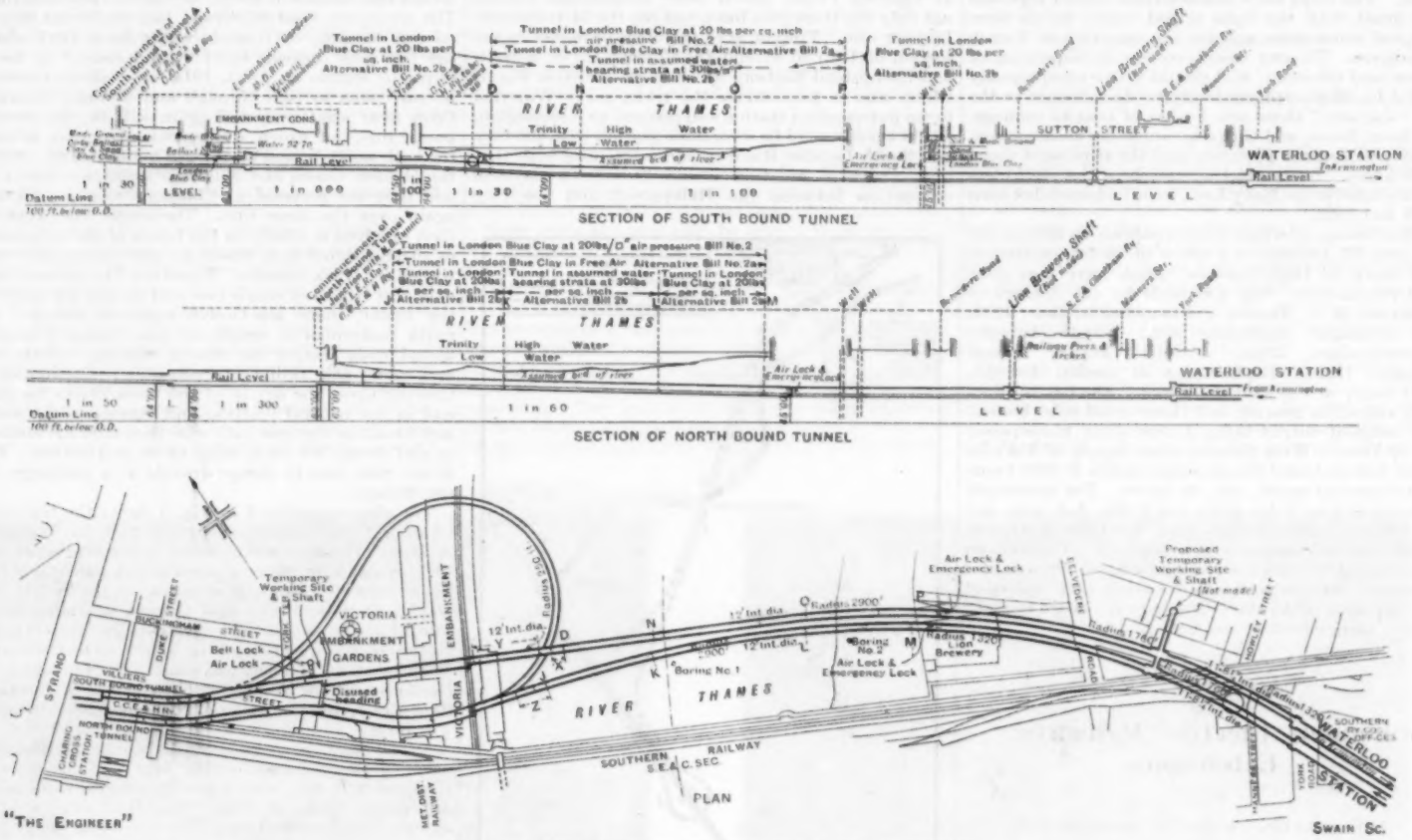

Tunnel in London Blue Clay at 20 lbs per sq. inch
Alternative Bill No. 2a
Tunnel in London Blue Clay at 20 lbs per sq. inch air pressure Bill No. 2
Tunnel in London Blue Clay in Free Air Alternative Bill 2a
Tunnel in assumed water bearing strata at 20lbs/s" Alternative Bill No. 2b
Tunnel in London Blue Clay at 20 lbs per sq. inch Alternative Bill No. 2b
RIVER THAMES
Trinity High Water
Low Water
Assumed bed of river
Rail Level
EMBANKMENT GDNS
SUTTON STREET
WATERLOO STATION
LEVEL
1 in 30
1 in 100
1 in 60
1 in 50
1 in 300
Datum Line 100 ft. below O.D.
SECTION OF SOUTH BOUND TUNNEL
SECTION OF NORTH BOUND TUNNEL
Temporary Working Site & Shaft
VICTORIA EMBANKMENT GARDENS
EMBANKMENT
Bell Lock
Air Lock
Disused Loading
Boring No. 1
Boring No. 2
Air Lock & Emergency Lock
Lion Brewery
Proposed Temporary Working Site & Shaft (Not made)
SOUTHERN RAILWAY
S.E.C. SEC.
PLAN
"THE ENGINEER"
SWAIN Sc.

FIG. 3—THE LINE BETWEEN CHARING CROSS AND WATERLOO

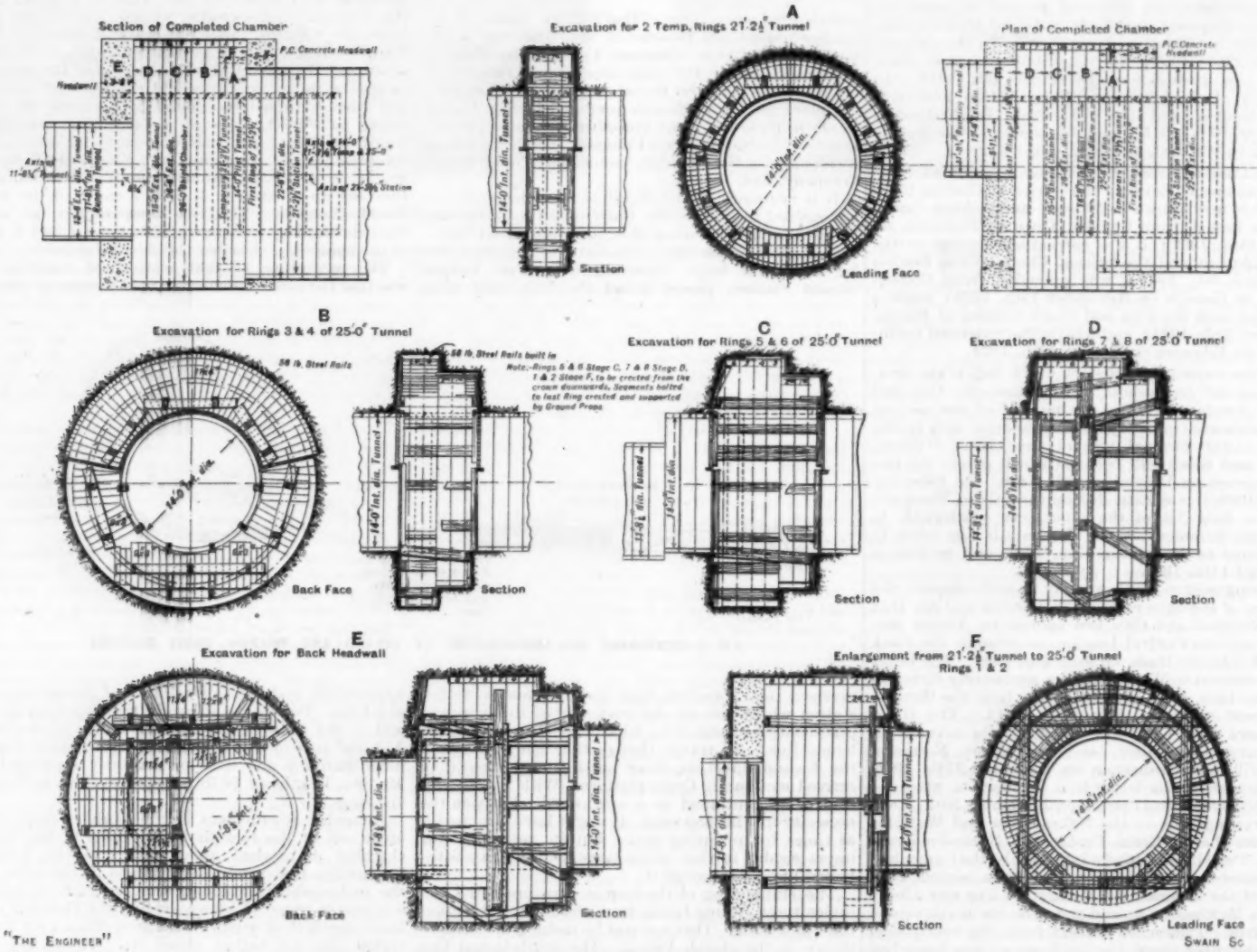


FIG. 4—CONSTRUCTING THE 25ft. INTERNAL DIAMETER SHIELD CHAMBER

completed, it was jacked up to the ordinary height.

This hooded shield having been erected, it was driven in a southerly direction, under compressed air, for a distance of 350ft., including the length of the shield chamber; then, by hand mining, for 230ft. in a northerly direction in order to join up to the existing south-bound line. At the latter point the disused loop line was cut off at B in Fig. 5 by a head wall 5ft. thick, and the recess behind the new tunnel was filled in with concrete. At the southern end E of the new station the top of the tunnel passed through about 2ft. of water-bearing strata, and in order to make the head wall water-tight a bulkhead—Fig. 6—of special castings was erected. Beyond that point six rings of running tunnel, 11ft. 8¼in. internal diameter, were placed in position, and a brick head wall was built inside to hold the air from the south-bound tunnel, under the river, which was being driven from the south side of the Thames. That point marked the end of the work done on the south-bound road from the shaft in the Embankment Gardens.

Leaving for a moment the work on the north-bound line at Charing Cross, we would say that both the south-bound and the north-bound tunnels under the Thames were driven from the south side of the river. It was intended to begin operations from a shaft in the yard of the Lion Brewery with a cross heading between the two lines, as shown on Fig. 3. That idea was, however, abandoned, and instead a shaft was sunk near the Baker-street and Waterloo station in York-road. A 15ft. shield chamber was built in a space now occupied by the north-bound platform of the Waterloo Station of this extension, and after excavating an opening of 12ft. diameter, for the north-bound line, to a point north of where the station would be, a cross heading was made, and a second 15ft. shield chamber built for the south-bound road. Both tunnels, which are 12ft. internal diameter, were then driven northwards under free air for a distance of 1400ft. on the south-bound line and of 1570ft. on the north-bound. The former distance included 521ft. under the river from the south side, and the latter had 514ft. The remaining 520ft. on the south-bound and the 539ft. on the north-bound were done under compressed air. The pressure for the first 129ft. of the 520ft. on the south-bound was 10 lb. per square inch; on the remainder, owing to the reduced cover, it varied, to suit the rise and fall of the tide, from 10 lb. at low tide to 20 lb. at high water. The corresponding figures for the 539ft. on the north-bound tunnel were 24lft. for the low pressure and 298ft. for the high. A full face of London blue clay was met with throughout. Air locks and emergency locks were provided immediately on the land side on the south of the river. The change in the position of the shaft necessitated the internal diameter south of the Lion Brewery and up to the York-road shaft being 12ft., as under the river, and not 11ft. 8¼in., as shown in Fig. 3.

The south-bound line, being driven from the Waterloo side, met the former loop at a point 150ft. north of the Embankment wall, as shown at F in Fig. 5. What was done there will be better appreciated by reference to Fig. 7. The loop, at that time, was out of use, so both sides were sealed up in concrete, and the intervening portion through which the south-bound line had to pass was also filled in with rough brickwork in weak lime mortar. Thus whilst the tunnelling has been in progress there has been no weakness in the loop tunnel, and the rough brickwork just mentioned has been removed piece by piece as the excavation has gone forward.

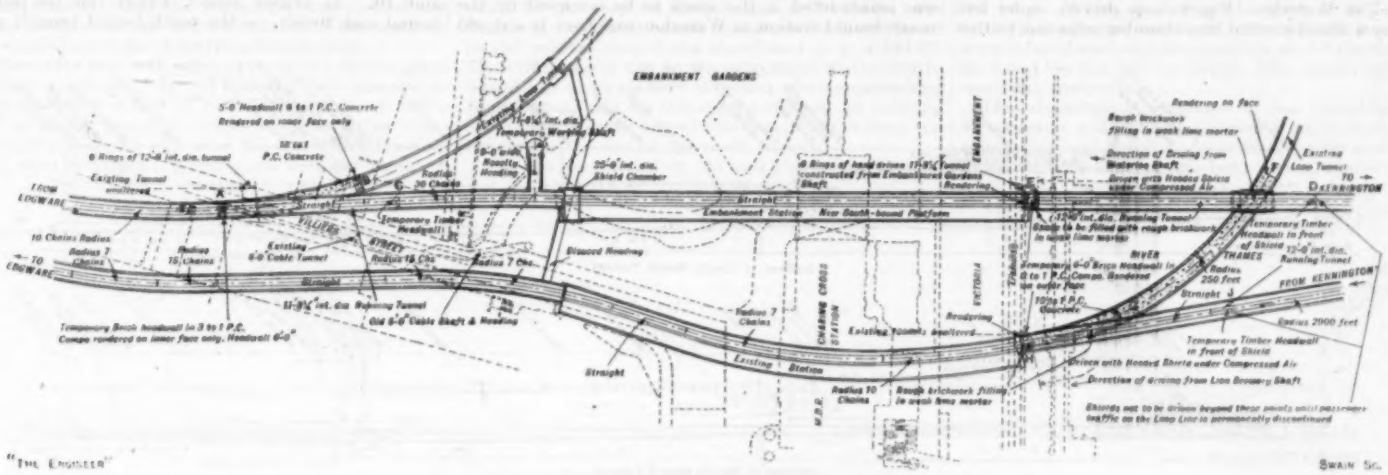


FIG. 5—ARRANGEMENT OF NEW STATION AT CHARING CROSS

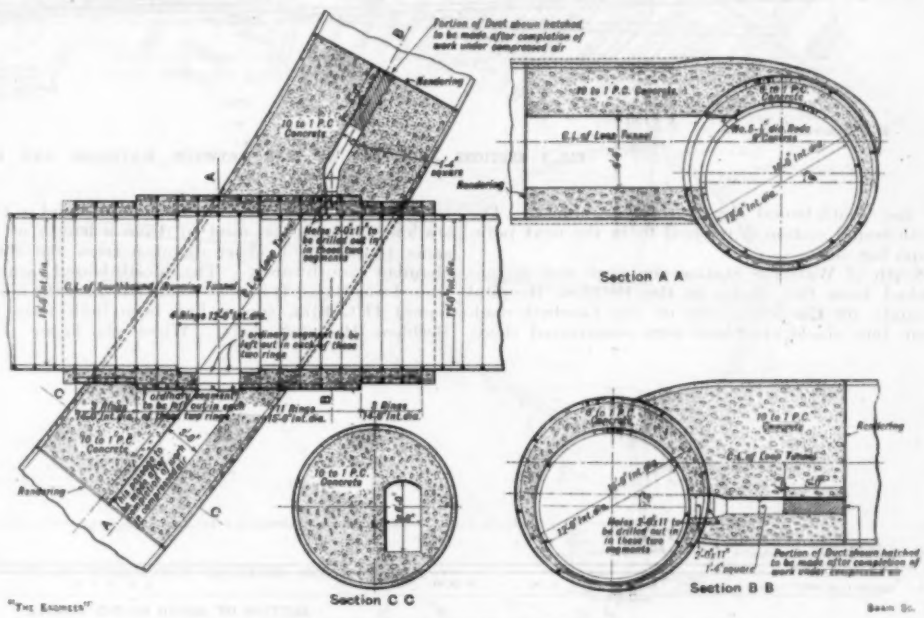

Portion of Duct shown hatched to be made after completion of work under compressed air
Rendering
10 to 1 P.C. Concrete
C.L of Loop Tunnel
Section A A
Holes 5-6½" to be drilled out in 10 loose tore segments
Section C C
Section B B
"THE ENGINEER"
SWAIN Sc.

FIG. 7—THE TUNNEL CUTTING THROUGH EXISTING LOOP TUNNEL

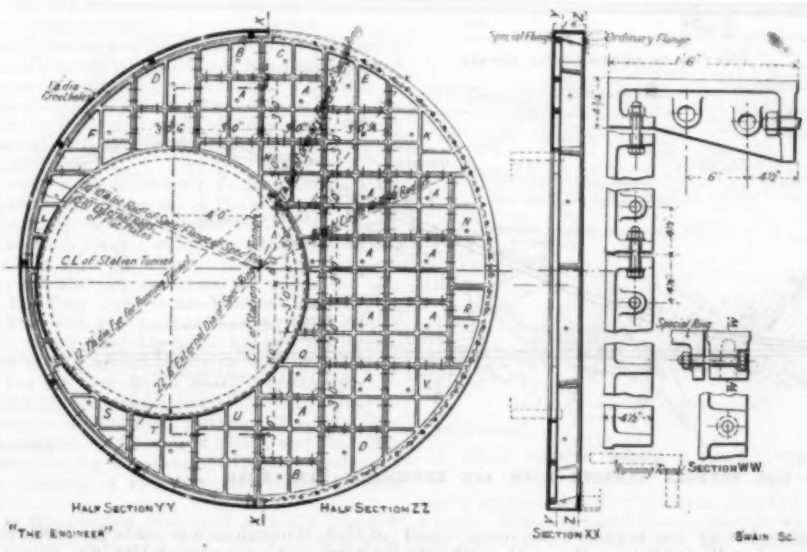


FIG. 6—BULKHEAD

When the shield reached the position on the right of the plan in Fig. 7, three rings of 14ft. internal diameter were excavated for by hand and erected. Steel poling boards were used to support the ground whilst mining was in progress. After those three rings were in place, the excavation was carried on by hand for eleven rings of 15ft. diameter. Steel poling boards were used for the step up from 14ft. to 15ft. When these rings were in position, three further 14ft. rings were joined up. The shield was then pushed through the eye, and within the seventeen rings those of the same dimensions—12ft.—as used under the river were fixed, and the space between the two rings was filled with concrete. The south-bound line was then finished up to the point E on Fig. 5, which made communication on the south-bound line complete.

An interesting incident occurred during that last stage. When about 40ft. from the Victoria Embankment wall, two old caissons, which had been used by the old Metropolitan Board of Works for building the Embankment wall, filled with concrete, were met with. They projected a short distance into the line of the work and had to be cut through.

Turning now to the north-bound line, it will be noticed from Fig. 5 that at the south end of what was, and is to-day, the only station at Charing Cross, and which will be the north-bound station there, was erected a brick head wall, 6ft. thick, to hold the air from the north-bound tunnel. The whole of the loop tunnel west of the intersection of the south-bound tunnel was filled with concrete, as seen, but where the north-bound line had to come in it was filled with rough brickwork only. When the north-bound tunnel reached that point the brickwork was cut through, and when the railway is opened the new north-bound line will be joined to the existing line and the station will be for north-bound trains only. The communication chamber, 3ft. wide and 6ft.

high—shown in Fig. 7—to be cut between the new south-bound and north-bound tunnels, has not been executed.

Very little work was carried out southwards from the shaft in York-road. The south-bound station tunnel at Waterloo—Fig. 8—was driven, under free air, by a shield erected in a chamber adjacent to that

The north-bound station at Waterloo is under the Southern Railway Company's offices and a portion of the Waterloo and City Railway. In the beginning of the description above of the work executed from the York-road shaft, it was said that a 15ft. shield chamber was constructed in the space to be occupied by the north-bound station at Waterloo, and from it a shield

by hand under free air from the same point. The length of the line from the south end of Waterloo Station to the Bethlem Hospital shafts is shown in Fig. 8.

The continuation of the railway is shown in Figs. 9 and 10. As stated above, 1935ft. on the south-bound and 3088ft. on the north-bound tunnels were

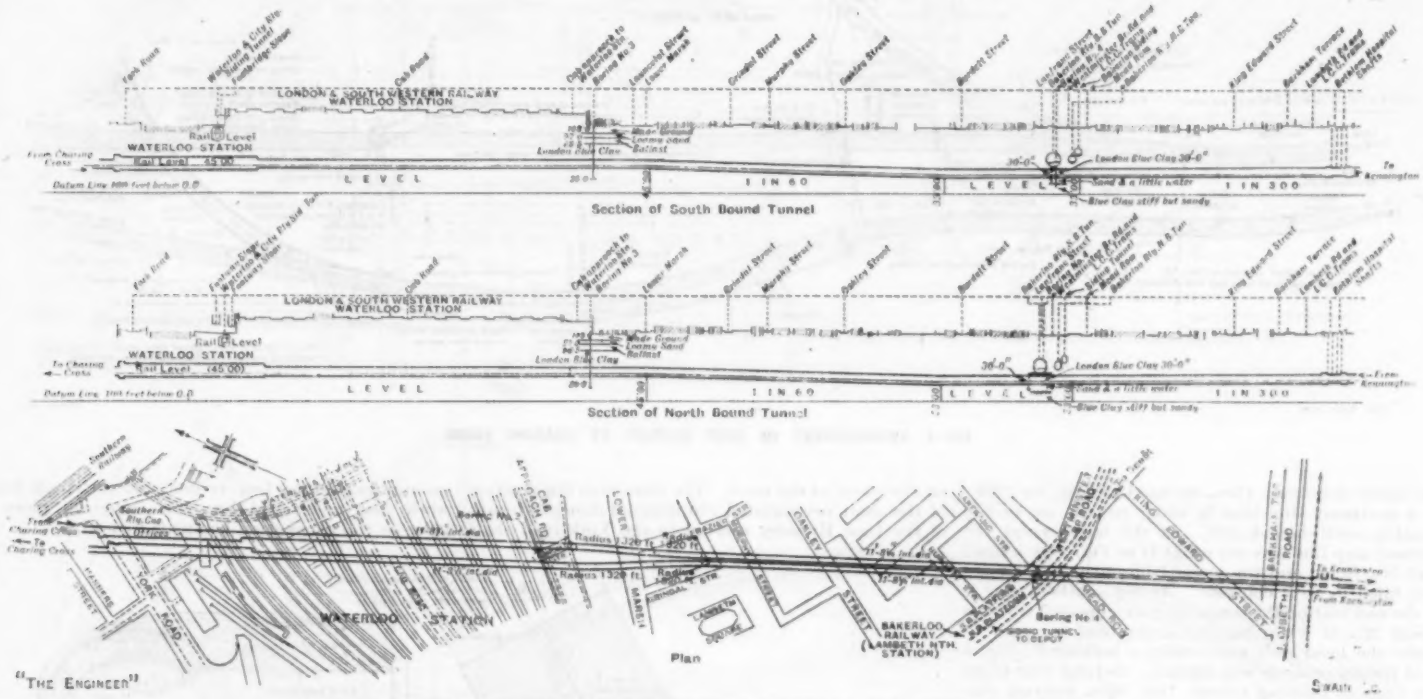


FIG. 8—SECTIONS AND PLAN OF LINE BETWEEN WATERLOO AND BETHLEM HOSPITAL

of the south-bound under-the-river shield. The north-bound station is referred to in the next paragraph but one.

South of Waterloo Station the work was accomplished from two shafts in the Bethlem Hospital grounds, on the south side of the Lambeth-road. Four 15ft. shield chambers were constructed there,

for a 12ft. tunnel was driven to the north end of that station. It was also used to drive a length of the same tunnel for a short distance from the shield chamber southwards. The north-bound station tunnel was then left in that condition until the north-bound 11ft. 8¼in. tunnel had been built from the Bethlem Hospital shaft. When the latter work

driven from the Bethlem Hospital shaft. The rest of the work was carried out from a shaft in Kennington Park, near the extreme right in Fig. 10. From the latter point a 12ft. 6in. internal diameter tunnel —the larger size being to suit the curvature of the loop—was driven to the southern end of the south-bound station at Kennington. A temporary tunnel

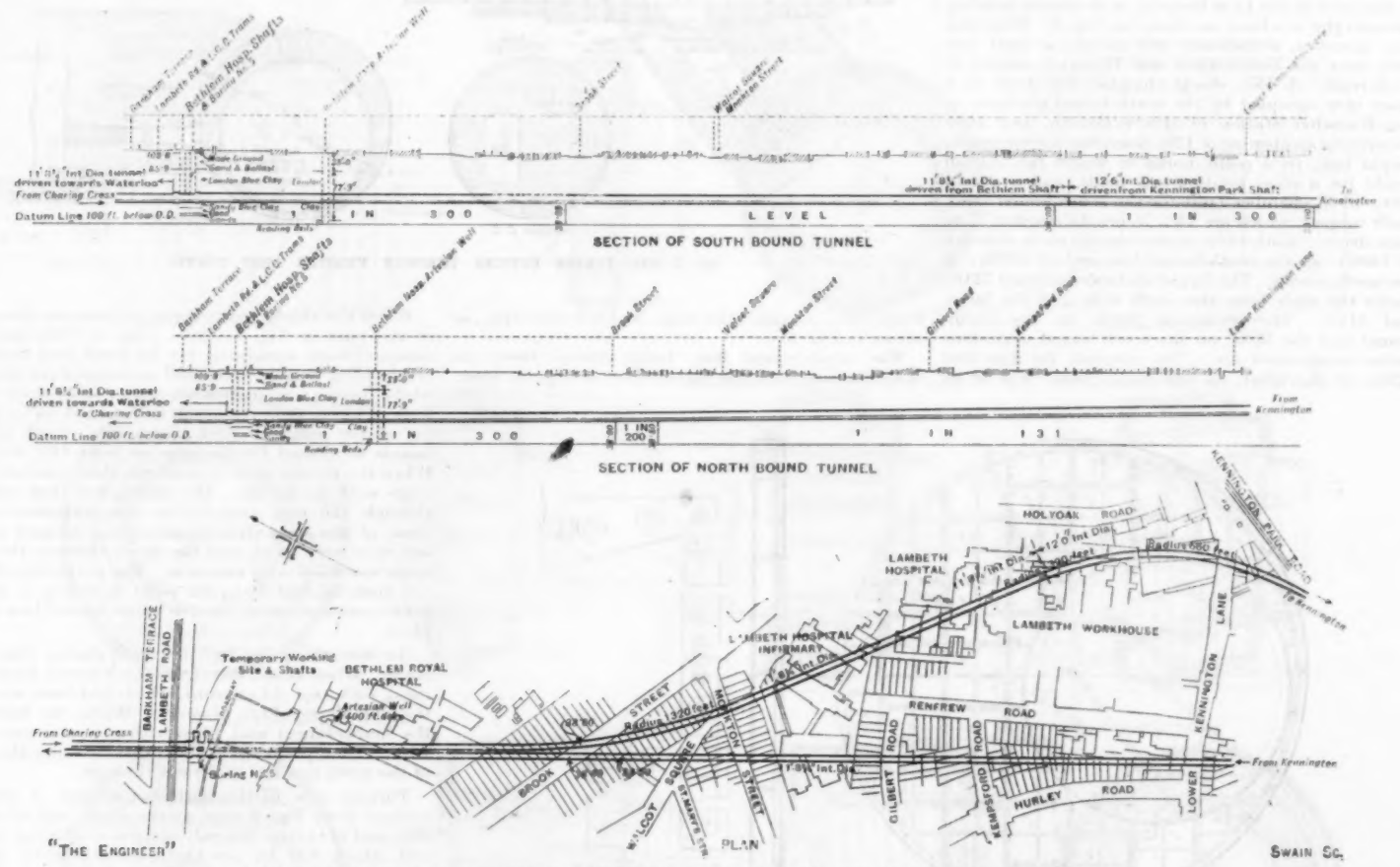


FIG. 9—SECTIONS AND PLAN OF LINE BETWEEN LAMBETH-ROAD AND KENNINGTON PARK-ROAD

and north-bound and south-bound tunnels towards Waterloo and towards Kennington were driven simultaneously through London blue clay and under free air. The distance driven towards Charing Cross on the south-bound line was 2595ft., and on the north-bound 2567ft.; towards Kennington it was 1935ft. on the south-bound and 3088ft. on the north-bound lines.

was completed work was begun on the north-bound station tunnel at Waterloo from the south end by the Bethlem Hospital shaft. That was, of course, 21ft. 2½in. diameter, and as that meant a considerable exposure of earth at one time, it was decided to cut out a further short length of 12ft. tunnel from the York-road shaft, and to enlarge the whole length of 12ft. tunnel in the station to the larger dimensions

of these dimensions was made for 350ft. through the station, and a permanent 12ft. 6in. tunnel continued until that driven from Bethlem Hospital was met, *i.e.*, a total distance of 1910ft. from the south end of Kennington south-bound station. From a point 150ft. north of the north end of that station to the junction with the tunnel driven from Bethlem Hospital the work was done under compressed air.

In that relation it should be observed that, when the Bethlem Hospital section on the south-bound line was nearing Lower Kennington-lane and the end of its own section, water was encountered, which suggested that the Woolwich and Reading beds had been tapped. A head wall was therefore built and the tunnel caulked, and the remainder was carried out under compressed air in continuation of the work on the south-bound line done from Kennington.

The strata met with when approaching Kennington Station on the south-bound line were very unusual, in that there was a bed of rock for a length of 903ft. and of a maximum thickness of 2ft. Other components to contend with were Woolwich and Reading clay, sand and shale; oyster shells were also found.

That step-plate has its smaller dimensions at the southern end. On the north-bound line is a similarly built connection, except that it is in a trailing direction.

The length of the new south-bound line from its commencement under Villiers-street to the midway point of the loop at Kennington is 10,858ft.; the length of the north-bound line from the latter point to the western end of the abandoned loop is 9848ft. The difference is due to the alignment of the south-bound line in an easterly direction when approaching Kennington, and to the commencement at Charing Cross for the south-bound line being further from the river than the end of the north-bound.

The sharpest curve on the new line is on the loop

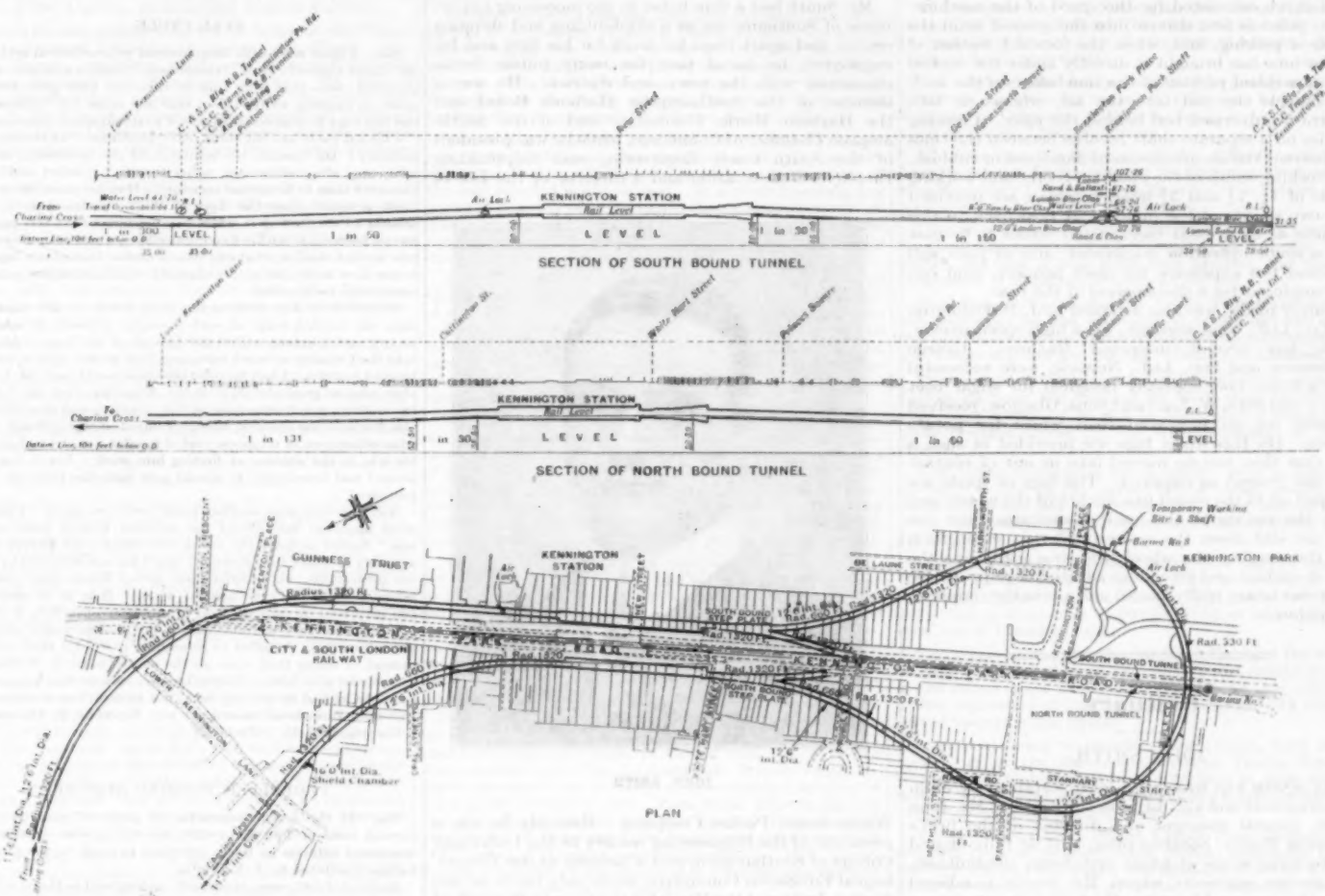


FIG. 10—KENNINGTON TERMINUS SHOWING LOOP

The particular length of the south-bound line now being referred to also passed under both tubes of the City and South London Railway; the south-bound line of the latter was 2ft. 5in. above the top of the new line and the north-bound line was 4ft. 1in. above. The crossing is seen at A in Fig. 11, which illustration also shows how ten old 45ft. rails, weighing 87 lb. per yard, are embedded in concrete in the invert of the two City and South London tunnels at the point of intersection.

It should be remarked that because of the proximity of the water-bearing Woolwich and Reading beds and the consequent desirability of excavating as little as possible in them, the rail level was raised 1ft. and a flat-bottom invert used through the south-bound station tunnel; 2ft. of excavation in that strata were thereby saved.

In the reverse direction from the Kennington Park shaft the loop was driven up to the south end of the north-bound station, a distance of 1805ft. That work was carried out in free air, except for a length of 391ft., where not only were the Woolwich and Reading beds met with, but the line again passed under the two tubes of the City and South London Railway, as shown at B in Fig. 11. In that case the south-bound line of the latter was only 15in. above; the north-bound was 9ft. Ten old 30ft. rails were used in the inverts. On the completion of the loop tunnel, the north-bound station tunnel was built and the north-bound tunnel—driven from Bethlem Hospital—was met. The radius of the loop is 330ft., and the rings are of radial iron for a distance of 1264ft. equidistant from the crossing of the City and South London Railway.

South of Kennington Station is a facing junction with the south-bound City and South London line. It necessitated the construction of the step-plate junction shown in Fig. 10, which extends for a length of 168ft., and varies in internal diameter from 12ft. 6in. to 27ft. The connection is carried in a 12ft. 6in. tunnel for 145ft., and then through a second step-plate junction to the City and South London Railway.

at Kennington. It is there of 5 chains radius; the easiest curve is one of 44 chains. The usual accelerating gradient of 1 in 30 falling is provided on leaving stations and the usual retarding gradient of 1 in 60 rising is given at the entrance to stations. Escalators are being provided at Charing Cross and Waterloo.

The signals will be of the automatic, two-aspect type, colour-light. The electro-pneumatic train stops are fitted with a proving scheme to ensure that they

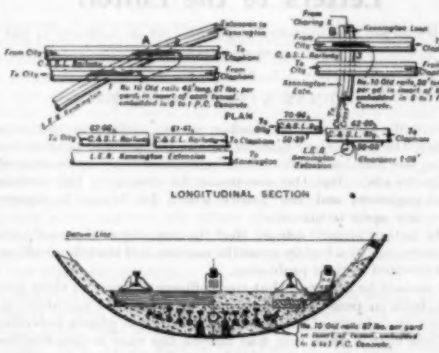


FIG. 11—PASSING UNDER C. AND S. L. TUNNELS

return to the "danger" position after the passage of a train. The only signal box on the line will work the two junctions at Kennington, and contain a power-operated frame of thirty-one levers, two of these being King levers in order to enable either the signals on the loop line or the City line, or on both lines, to be worked automatically. The points will be actuated on the electro-pneumatic principle.

The junctions just named will allow Charing Cross trains to go to and from Morden, but that, it is expected, will only be done during the rush hours; at other times the Charing Cross–Morden passengers will change at Kennington and use the City and South London trains. Those trains that do not pass on to the Morden line will reverse by running round the loop. When, as during the time of less traffic in the late morning and early afternoon the junctions are not being used, the points will be set for the straight lines and the box will be closed. The signals will then work automatically.

The illuminated diagram in the signal-box at Kennington will indicate the condition of both lines of the City and South London Railway for some distance on each side of the box, of the whole of the loop and of both lines towards Waterloo. The indications will have a characteristic not hitherto used in this country. When the sections on the diagram are illuminated, and thereby indicate that they are clear, the indication given will be a green one. That colour has been adopted because it is more restful to the signalman's eyes than white; it is also the same as that of a signal at "clear." This particular cabin diagram indicates for a total area of 4½ miles.

Another interesting feature at Kennington is one designed to meet the difficulty that when the signal-box is closed there will be no signalman to send an intimation as to the destination of trains on the north-bound platform train indicator boards. Arrangements have been made that when the King lever is pulled over, making the signals automatic, the north-bound train description circuit will be connected to the south-bound. Thus, the description sent from Camden Town for south-bound trains will, at Kennington, be passed on to the north-bound circuit, and actuate the north-bound train-describers exactly as though that were being done from Kennington.

Royal Agricultural Show Awards.

We are not acquainted with the system adopted by the judges in allotting the Royal Agricultural Society's silver medals for new implements. This year there were nearly fifty appliances of various kinds competing for these coveted trophies, and the judges awarded medals to four of them. We feel sure there were others almost if not quite equally deserving of the awards, but presume that there is a definite limit to the number to be given each year. Major Hammond Foot received one of the medals for a new rotary tiller invented by himself, and built by the South Lincolnshire Agricultural Engineering Company. The inventor claims that this machine can be operated by one man, that it has a capacity of 10 to 16 acres

per day, and that it can produce a fine or coarse tilth as desired, up to 10in. depth, while the consumption of petrol is from 2½ to 3½ gallons per acre. The Hammond tiller is propelled by a white and Poppe petrol engine of 68 brake horse-power. This engine drives through a flexible coupling, and a universal joint and gearing, a miller consisting of curved tines of spring steel revolving round a central shaft. The whole is so balanced on two large travelling wheels that when the miller is raised from the ground at the end of each bout—the raising being done by a hydraulic oil pump—the front part of the machine is a counterpoise, and by de-clutching the inside driving wheel, it is possible to pivot the machine on its axis. The tines of spring steel have a pick and shovel action, and when the machine is in motion, work on a spiral curve calculated for the speed of the machine. A 4in. point is first driven into the ground as in the action of picking, and, when the forward motion of the machine has brought it directly under the central shaft, a webbed portion of the tine takes up the work and shovels the soil into the air, whence it falls to form a pulverised bed behind the tiller. Cleaning paddles on a separate shaft revolve between the tines and prevent the accumulation of damp soil or rubbish. The working width of the machine is 5ft., and working speeds of 1¼, 2½ and 3¾ miles per hour are provided with two speeds of the millers. A drawback to this machine as at present constructed seems to be that it is a single-operation implement, and as such will be found too expensive for most farmers, who can only employ it for a short period of the year.

A silver medal was also awarded to J. B. Edlington and Co., Ltd., Gainsborough, for a high-speed mower, which has several improved features. George Stephenson and Son, Ltd., Newark, were successful with a horse hoe, specially designed for sugar beet crops; and John W. Lace and Sons, Glasgow, received a medal for an improved road wheel for potato diggers. On this wheel lugs are provided in such a way that they can be moved into or out of contact with the ground as required. The lugs or spuds are clamped on to the round iron spokes of the wheel, and when the nature of the land necessitates their use they are slid down the spoke until they come flush with the tread of the wheel tire, thus increasing the area of contact and providing additional grip. These attachments are really useful and perfectly simple to manipulate.

Obituary.

JOHN SMITH.

THE severe loss which has been sustained by John I. Thornycroft and Co., Ltd., in the death of Mr. John Smith, general manager and director of the firm's Woolston Works, Southampton, will be fully shared by the large circle of naval architects, shipbuilders, and marine engineers whom Mr. Smith numbered among his personal friends. He died at Southampton on Tuesday morning last, following an operation for appendicitis, and was only fifty-two years of age.

John Smith was a Greenwich schoolboy, and his personality when at school early attracted the attention of Sir William Niven, who was then Director of Studies at the Royal Naval College. In 1889 he passed from school at Greenwich to Portsmouth Dockyard as an apprentice shipwright, and in 1893 he was one of two apprentices selected by Sir William Niven for twelve months' training at the Royal Naval College at Keyham. From there he proceeded to the Royal Naval College at Greenwich, finishing his three years' course in 1897. After leaving Greenwich he entered the Royal Corps of Naval Constructors and went to sea for twelve months in the battleship Majestic when she was the flagship for the old Channel Fleet. Mr. Smith was appointed to the Admiralty in 1899, and he served for several years on the staff of the Director of Naval Construction. He was the professional secretary to Sir William White during his term of office as Chief Naval Constructor, and afterwards to his successor, Sir Philip Watts. Following these years at the Admiralty, Mr. Smith was appointed in 1904 an Instructor in Naval Architecture at the Royal Naval College at Greenwich, where he remained in the capacities of Junior and Senior Instructor until 1907. He then returned to the Admiralty and was put in charge of the light cruiser design section. Between the years 1907 and 1910 he continued to give lectures in naval architecture at Greenwich, and from 1908 to 1910 he was a lecturer on "Stability" to the senior officers attending the War College at Portsmouth. Early in January, 1911, Mr. Smith was appointed Clyde Admiralty Overseer to supervise the building of battleships. During that year he was specially associated with the building of the battleship Ajax at the Greenwich yard of Scott's Shipbuilding and Engineering Company, Ltd. In the October of 1911, however, Mr. Smith resigned from Admiralty service and accepted a post with J. Samuel White and Co., Ltd., of East Cowes. In 1915 he was appointed managing director of the firm, but in 1919 he resigned this position and was appointed general manager and director of the Woolston Works of John I. Thornycroft and Co., Ltd., at Southampton.

At Southampton Mr. Smith found wide scope for his many-sided activities. He was a prominent member of the Institution of Naval Architects and served on the Council of that body. Evidence of his keen interest in professional and scientific subjects will be found in the papers he read before the Institution of Naval Architects and to the British Association. During the war period Mr. Smith was a member of Lord Fisher's Board of Inventions and Research. During the greater part of his career Mr. Smith was associated with educational work and he was keenly alive to the importance of education before, during, and after apprenticeship. For this reason the welfare work at the Woolston Yard had a special appeal for him, and he it was who established the welfare department, for which a fine institute was built on the firm's Silvermere estate.

Mr. Smith had a firm belief in the increasing importance of Southampton as a shipbuilding and shipping centre, and apart from his work for his firm and his employees, he found time for many public duties connected with the town and district. He was a member of the Southampton Harbour Board and the Harbour Works Committee and of the Southampton Chamber of Commerce, while he was president of the South Coast Engineering and Shipbuilding Employers' Association and a director of the Isle of

JOHN SMITH

Wight Steam Packet Company. Recently he was a president of the Engineering Society of the University College of Southampton and a member of the Technological Education Committee, while only lately he was made a Justice of the Peace for the County Borough of Southampton. Mr. Smith had a keen interest in sport, more especially where his employees were concerned, and he himself was an able yachtsman. Another interest, however, which perhaps formed his principal relaxation was the study of antiquarian and archæological subjects, in which he was locally assisted by his membership of the Hampshire Field Club.

Mr. Smith possessed a singular charm of personality and his death is a great loss, not alone to his employers, but also to a wide circle of professional and private friends.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

GERMAN NAVAL ENGINEERS.

SIR,—We agree that the author of the article in your issue of May 21st on "The Status of Naval Engineers," prior to and during the war, has made his observations with a certain amount of exactitude. But the conclusion he draws on the German naval engineer, and the proofs which he brings to support them, are open to question.

The author himself admits that the training of German naval engineers was of a highly scientific nature, and that these officers were devoted to their profession.

It cannot be assumed that such officers did not do their level best, both in peace and war time, to reach and maintain the highest standards of efficiency for the naval plants entrusted to their care. That this was indeed the case is not doubted by any one having an intimate knowledge of the war condition of the German navy.

The author cites the naval chief of that time, Admiral v. Pohl, as the Crown witness for the conclusions reached in the article. The Admiral's diary, however, merely contains notes which evidence his frame of mind under various circumstances, and the facts are only generally stated without entering upon causes. What is said here about the failure of different engines cannot be traced back to faulty management or unwillingness on the par of the officers, but to the simple fact that Germany was in difficulties with regard to certain raw materials very soon after the outbreak of war. The lack of these necessitated the use of inferior substitutes, both for repairs and new constructions, at a comparatively early date, with the result that the durability and service of the engines was unfavourably affected.

Generally speaking, the English naval shipbuilding speed was always superior to the German, unit for unit compared. The German navy used a greater percentage of the water displacement for armament, while the English utilised more for the engines.

If no mention has yet been made of the achievements of German naval engineer-officers during the war, in those contributions to history which have appeared up to date, this does not necessarily mean that their part was an insignificant one. The adage which says that "the best wife is she about whom least is spoken" may well apply in this case.

In conclusion, we have to say that the author's examples to prove the extent to which the ships' mechanical power depended upon the status of the naval engineers and their relation to naval officers, are not happily chosen.

DIE VEREINIGUNG DER INGENIEUROFFIZIERE DER MARINE.
Chairman: RACHLERTS, Captain (retired),
Naval Engineering Department.

FULL CYCLE.

SIR,—I have read with deep interest your editorial article on Mr. Garet Garrett's book "Ouroboros," since it endorses strong personal views that from time to time you have permitted me space to express, to the effect that the craze for "efficiency" can but lead to stalemate if pushed to its ultimate conclusion.

I take it there are but three real "producers" in the whole of industry: the farmer, the hunter, and the fisherman, and all who come after administer rather to man's comfort and entertainment than to his actual necessity. How far these latter have made progress since the days of Watt one has only to look around to see, but it is when one considers that the progress has all been made within two hundred years and at an increasing rate in each decade, that one has to realise that man's capacity to produce must outrun his capacity to absorb unless a halt is somewhere to be called.

Undoubtedly the solution lies in a return to the land, and since the limited scope of such a course prevents its adoption to any useful extent within the bounds of the home islands, it is to the Colonies we must turn, and that at once and in no half-hearted manner. I had thought that this would have made itself plain almost from the date of the Armistice, but the "dole" has checked much enterprise in this direction and done incalculable harm to the country, though I admit it was difficult to see what other form of temporary relief to offer a man who had done his job, in the absence of finding him work; but it has been abused and overdone. It should now take the form of "paid passages."

And I would urge another point yet once again. Unrest is more apparent throughout the civilised Powers than ever it was. Sooner or later the storm will break over Europe again as surely as water runs downhill, and I am not ashamed to name the contestants, viz., Christianity *versus* Bolshevism—creation *versus* destruction, right against wrong. It is all so clear that one may venture into the field of prophecy cheerfully if only it will have one iota of influence on our present youth and help them turn their thoughts to something useful for their country instead of fixing their eyes on the centre court at Wimbledon as their *ne plus ultra*. Better money, cleaner life, happier old age is to be had by getting back, not to zero, but to reasonable standards of natural existence. STANLEY P. CHRISTIE.

Chelsea, S.W. 10, July 17th.

PROPELLER TURBINE RUNNER.

SIR,—In the article appearing on pages 57 and 58 of the current issue of THE ENGINEER, describing some of the more important exhibits at Basle, reference is made to the propeller turbine exhibited by J. M. Voith.

As exact details were apparently lacking and as this is not only actually the largest turbine exhibited, but also one of the largest propeller turbines yet constructed, it may be of interest if a few particulars are given.

This turbine is one of the eight machines to be installed at the Kachlet power plant on the river Danube. The head varies between 7·65 m. and 9·2 m., the output of these two heads respectively being 7500 and 9320 horse-power per turbine at a speed of 75 revolutions per minute. The propeller is unique in Germany as regards size and weight, having a diameter of 4·6 m. and weighing 22 tons.

It is also worth noting that, as no precedent existed in respect to the design of such a propeller, it was necessary, in order to ensure that the specified guarantees could be met, to carry out very careful experiments with model runners, the first of which was 250 mm. diameter. On the data so obtained a second model, 700 mm. in diameter, was made and tested, the cumulative results of these two series of tests determining the details of the design of the 4·6 m. propeller. MICHAEL PERRIN.

London, July 16th.

RETAINING WALLS AND GEOSTATIC THEORIES.

SIR,—In THE ENGINEER for June 11th, on page 605, Mr. Woods says:—"It is reasonable to suppose that the earth pressure against such a wall could not have exceeded that due to the triangular prism A O M."

I should be much obliged if Mr. Woods would kindly give the reasons why such a supposition must be considered reasonable.

Glasgow, July 13th. J. V. NIMMO.

THE report to the Ministry of Transport by Major Hall on the buffer stop collision of March 7th last at Brighton Station has recently been issued. The date in question was a Sunday, and the driver had only twice before worked that particular train. It had then run into No. 4 road, instead of into No. 10, as on the present occasion. The signals at the entrance to the platform have an upper stop and a lower distant arm. When both are "off" the road is clear up to the buffers; when the top arm only is "off" and the distant is "on" the further 257ft. out of the total length of 493ft. are occupied. The latter was the condition prevailing when the train in question was admitted, but the driver failed to pull up in time, and his train ran into five standing vehicles. There were mitigating conditions that make some excuse for the driver, and Major Hall says that neither driver nor fireman could be accused of inattention to the road ahead. Although the signalling is, as the report observes, unusual, the men concerned know it, and the inspecting officer has no recommendation to make as a result of the accident.

Railway Matters.

As an up passenger train was near Helpston, on the Syston-Peterborough branch of the London, Midland and Scottish, on the evening of Thursday of last week, five carriages were derailed. There were no serious personal injuries. It was suggested that the road had been damaged by a previous goods train.

ENCOURAGED by the success of the Railwaymen's Day at Belle Vue Gardens, Manchester, on the actual date, in September last, of the centenary of railways, it is proposed to have a great Railway Pageant there on Saturday, September 25th. It may be remembered that the gathering last year was held with the encouragement and supported by the presence of Mr. H. G. Burgess and other leading officers of the London, Midland and Scottish Railway.

AMONG the ten members elected by ballot to the Council of the Institute of Transport are four railway officers:—Mr. C. R. Byrom, assistant chief general superintendent, London, Midland and Scottish Railway; Mr. George Ellson, deputy chief engineer, Southern Railway; Mr. W. G. P. Maclure, chief running superintendent, Southern Area, London and North-Eastern Railway; and Mr. Henry Wheeler, assistant to the general manager, Great Western Railway.

FOLLOWING up what was said on page 9 of our issue of July 2nd as to no solution being forthcoming that would dispense with the hanging buffers required for wagons used on the self-acting inclines on the North-Eastern area it is now announced that the London and North-Eastern Company is grateful for the public interest shown in connection with the attempts to solve the difficulty, and has decided to award three guineas each to five of the best designs submitted.

IT was hoped to open the Morden extension and the Charing Cross and Kennington new tube of the London Electric Railways in June, but the general strike delayed the engineering work, and a date in July was provisionally fixed. The coal dispute now prevents a full resumption of work, and the posters at the new stations can only say that they are to be opened "in August." It is meanwhile officially announced that it is hoped that the opening will not be delayed for more than a few weeks.

IN this column of our issue of the 9th inst., when mentioning the sentences passed at Newcastle Assizes on the men found guilty of maliciously removing a rail at Cramlington, satisfaction was expressed that the prisoners were not railwaymen. It is therefore with regret that we have to record that at the Staffordshire Assizes on July 6th a platelayer and a fireman pleaded guilty to displacing a rail on the up line and loosening one in the down line near Stafford on May 11th. They were sentenced to five years' penal servitude.

IT is hoped that the colour light signals for controlling road vehicles entering Piccadilly from the streets between Old Bond-street and Berkeley-street, and passing along Piccadilly between those points, will be brought into use on Monday next. As we have seen an incorrect description of the purpose of the different colours, we would say that just before the red "stop" light is to be changed to the green, "proceed," the yellow is shown as an intimation to drivers to get ready; when it is about to be changed from green to red yellow is shown to warn drivers.

IN a written answer to a question as to the railway companies' consumption of coal, the Minister of Transport stated that at an early stage of the emergency he impressed upon the companies the importance of conserving coal in view of the stoppage in the mines. It has been left to the companies to use their discretion in meeting the more essential needs, and in deciding how far they are justified in extending services they must have regard to their supplies, present and prospective. In recent weeks the consumption of coal by the railway companies has been substantially in excess of 50 per cent. of the normal consumption.

A BRIEF dispatch from the United States reports that a new type of locomotive has been built for the Union Pacific Company. It has three cylinders, twelve coupled driving wheels, and is 102½ft. long, 16ft. 1½in. high, and 11ft. 2in. wide. The engine is for service between Cheyenne, Wyoming and Ogden, Utah, which means that it will pull over the greatest altitude in western travel, namely, 8000ft., at the famous Sherman Hill in Wyoming. The message does not state by which firm this locomotive has been constructed, but it is described as being representative of the new engines placed on the market by private locomotive-building companies to compete with the high-powered electric engines.

THE last of the original lifts on the City and South London Railway are to disappear and be replaced by modern lifts running at double the speed. These are the lifts at London Bridge Station—Denman-street—which were put in in 1890. There are now 170 lifts on the Underground. Five years ago there were 230. The escalator is gradually superseding them as a means of taking passengers to and from the platforms. Twenty-four stations are now equipped with escalators, and fifty-one are in daily service. The starting up of the new Morden Tube extension will add a further twelve, and other new works now in hand at Piccadilly, Charing Cross, Waterloo, &c., will bring the total up to eighty-five.

IN this column of our issue of February 19th mention was made of a labour dispute which threatened all the railway electrical power houses in London. The point was that the companies wanted to withdraw the 6½ per cent. advance paid to their men in common with all other power houses. The railways claimed that the latter paid what was a "prosperity" bonus, but such could not apply to railway companies, as they had suffered from a long-continued and increasingly serious depression. The Industrial Court held an inquiry into the question, and on Saturday, July 10th, it made an award to the effect that the wages of the workpeople concerned do not compare unfavourably with the rates paid in other occupations in the railway industry, regard being had to the difference in the nature of the various occupations, and also that the present condition of the railway industry is not such as would warrant an advance in wages to a section of the employees.

Notes and Memoranda.

IT is suggested in the *Chemical Trade Journal* that there is prospect of para-nitrophenol taking the place of smoking for the curing of rubber on a commercial scale.

AS a prelude to the more thorough examination of the natural resources of the 700,000 square miles of the Province of Quebec, the whole area is to be mapped photographically from aeroplanes.

THE average annual consumption of electricity for domestic purposes is 718 units in Durban, while that of Johannesburg is only 238 units. Of South African towns, Pietermaritzburg is the lowest, with 155 units. The cost of generating and delivering to the mains in Durban is 0.296d. per unit.

IN order to cool a bearing, deep grooves were, according to Mr. L. A. Cowles, of South Dakota, cut in the lining, copper tubing was placed in the grooves and the torch used to run in babbitt metel over the tubes and to fill the grooves. The bearing was then scraped in and the tubing connected to the water supply. The result was a cool bearing that previously had given endless trouble.

THERE is an economic aspect to the question of cleanliness in boiler houses using powdered coal. It has been estimated that in some plants as high as 2½ per cent. of the coal handled is lost as dust. In a plant handling any material quantity of coal a loss of that magnitude would go a long way toward defraying the cost of making the plant entirely dustproof. Plants can be made absolutely dustproof.

A STUDY has been made by the American Bureau of Standards of the physical properties and crystal structure of pure zinc. Data are given on the following properties:—Coefficient of expansion, density, scleroscope and Brinell hardness, and tensile properties and crystal structure at normal and elevated temperatures. Proof is given that zinc has but one allotropic form between normal temperatures and the melting point.

CONCRETE, says Mr. J. G. Ahlers, of New York, is not controlled in strength by proportion of cement to sand and stone, but by ratio of cement to water only. The addition of sand and stone or gravel only makes the concrete either more economical or less economical, depending on whether much or little is added, or depending whether the sand and stone are well or poorly graded. The results of 100,000 tests at Lewis Institute are said to prove this statement.

ABOUT the only method of controlling a fire in a pulverised coal bin is, according to *Vulcan*, to cut off the feed to the furnace and empty the bin as quickly as possible, with care to avoid raising a dust cloud that might be ignited by contact with the burning coal. Some manufacturers equip bins with air-tight valves, which may be closed in case of fire, sealing the bins and preventing the admission of air. This provision has proved effective in at least two instances.

IN our articles on wire-working machinery we mentioned—see THE ENGINEER, October 3rd, 1924—cursorily that there were two forms of barbed wire, one of which was invented by Glidden (of America). It is thus interesting to discover in the *Iron Age* a more detailed account of the history of barbed wire. From these notes it appears that the idea of barbed wire was evolved so long ago as 1867 by W. D. Hunt and L. B. Smith, and it was not until 1874 that J. F. Glidden secured his patent. It is, nevertheless, conceded in the States that Glidden was the first successful inventor in this direction.

EXPERIMENTS carried out in America have shown that Paris green distributed by aeroplanes is an effective method of combating mosquitoes in swampy land. As the Paris green is effective in very small quantities, it was diluted by mixing with an inert carrier, fine siliceous earth being mostly used. No special difficulty was experienced in distributing the insecticide over open water or rice fields; the most difficult conditions encountered were in heavily-wooded areas where the water was protected by dense foliage. In the latter conditions a larger amount of the arsenical is required as compared with about half a pound per acre in open areas. In areas overgrown with aquatic vegetation, 88 per cent. to nearly 100 per cent. of the Anopheles larvæ were destroyed.

THE photogenic property, or darkening of lithopone paints exposed to moisture and sunlight, was, according to the *Chemical Trade Journal*, a serious handicap to the expansion of lithopone ten years ago. The manufacturers sought from the beginning to eliminate the fault, but were not entirely successful until about 1920. It was found that the ultra-violet rays in sunlight had a reducing effect on the zinc sulphide content of lithopone, converting it to metallic zinc and liberating hydrogen sulphide. Metallic zinc, being greyish in colour, darkened the white surface, the discoloration remaining so as long as the ultra-violet rays were present. With the removal of the sunlight, the metallic zinc quickly oxidises to white zinc oxide by the oxygen in the air and the surface becomes white again. In order to counteract the effect of the ultra-violet rays, a successful patented process now in use by some of the manufacturers forms an insoluble protecting film around the zinc sulphide content.

A DIFFICULT task of felling a blast-furnace stack in a confined space, with a clearance of scarcely 40ft. at the ground level, was accomplished with dynamite recently in Troy, New York, and is described in the *Iron Trade Review*. It was an old stack, which was 80ft. high and rated at 250 tons a day, built originally in 1906 and redesigned in 1912. The furnace was supported on eight cast iron columns running down below the ground level to concrete supports. The columns were drilled at ground level and filled with clay. Then in each column twelve sticks of dynamite were inserted and clay again packed on top. The bosh brick was removed from half of the furnace on the side toward the clear space, and then to prevent a "back kick" due to the tendency of the columns to hold to the stack, four additional sticks were placed at the top of each column and timed to explode about half a second after the explosion of the dynamite at the ground level. The stack itself was then cut loose from the charging tower and from the stoves, after which the charge was exploded and the furnace brought to the ground.

Miscellanea.

THE average production of Canadian newsprint mills is increasing at the rate of 1269 tons a day.

THE West End plant of the Hamilton Bridge Works Company, Ontario, is to be restarted after having been idle for three years.

DURING the year which ended with June, 1925, Australia imported paint to the value of £660,000, and of this amount Great Britain supplied £471,000 worth,

WORK will be started immediately on a new dam on the river Mackinac at about 20 miles from Shawinigan Falls, Quebec. The entire cost of the work will be about 500,000 dollars.

IT is proposed by the Norwegian Government that the Glomfjord Waterfall should be leased to the Aluminium Corporation of England, for the purposes of reducing aluminium oxide electrolytically.

THE artificial silk factory which is to be put up at Drummondville, Quebec, for Canadian Cellanese, Ltd., by the Foundation Company of Canada, Ltd., is to cost, fully equipped, some 7,000,000 dollars.

WE hear that His Grace the Duke of Northumberland has consented to be President of the Shipping, Engineering and Machinery Exhibition, which is to be held from September 8th to 24th, 1927, at Olympia.

DURING a week's trial run of the retort plant of the New Southern Cross Motor Fuels Company, at Latrobe, Tasmania, 35½ tons of local shale were handled, and yielded an average of 36 gallons of crude oil per ton.

THE Federal Parliamentary Public Works Committee has recommended the employment of a third rail as a means of allowing the Trans-Australian train to negotiate the change in gauge and get right through to Adelaide.

THE arrival of the new dredger Lord Willingdon at Cochin Harbour, has enabled the third stage of the improvement works to be put in hand, and a channel is being dredged across the bar for the passage of large vessels.

THE Indian Railway Board is seeking from motives of economy to find in the Indian forests cheap woods, the use of which will help to cut down the heavy bills for teak which are yearly incurred under the coach-building programme.

TRAFFIC through Canadian canals was heavier during 1925 by 1,261,570 tons, than in 1924, according to the Dominion Bureau of Statistics. The traffic of 1925 amounted in all to over 14,000,000 tons, of which 68 per cent. was of Canadian origin.

RADIO service has cost the Canadian National Railways to date 474,689 dollars in expenditure and indebtedness, it was stated in the House of Commons. Of this, 105,173 dollars represents capital expenditure and 369,515 dollars cost of operation and upkeep.

SOME coal mines at Batalha, near Lisbon, have been opened up by the Match and Tobacco Timber Supply Company. The output is from 1500 tons to 2000 tons a month, but the coal is of poor quality and needs the admixture of about 50 per cent. of Welsh coal.

A NEW record for the British Empire Steel Corporation shipping piers at Sydney, Nova Scotia, surpassing even the high mark of war years, was established on June 3rd, when between the hours of seven and midnight eleven large vessels were loaded with 26,850 tons of coal.

A NEW lightship, known as China Bakir lightship, to be stationed at the mouth of the Rangoon River, is being erected by the Port Commissioners. The vessel, which has a candle-power of 50,000, is reported to be the first of its kind in the East in respect of up-to-date arrangements and labour-saving devices.

A DECREE has recently been published stating that the Greek Government has signed a convention with the Eastern Telegraph Company granting the latter the exclusive privilege of the exploitation of the cable and wireless telegraphic communication between Greece and foreign countries for a period of fifty years.

THE secretary to the Australian Postal Department has announced that the department was about to open a new carrier wave telephone service between Sydney and Maitland, and that with this new service in operation a considerable improvement would be effected in the trunk line telephone service between Melbourne and Brisbane.

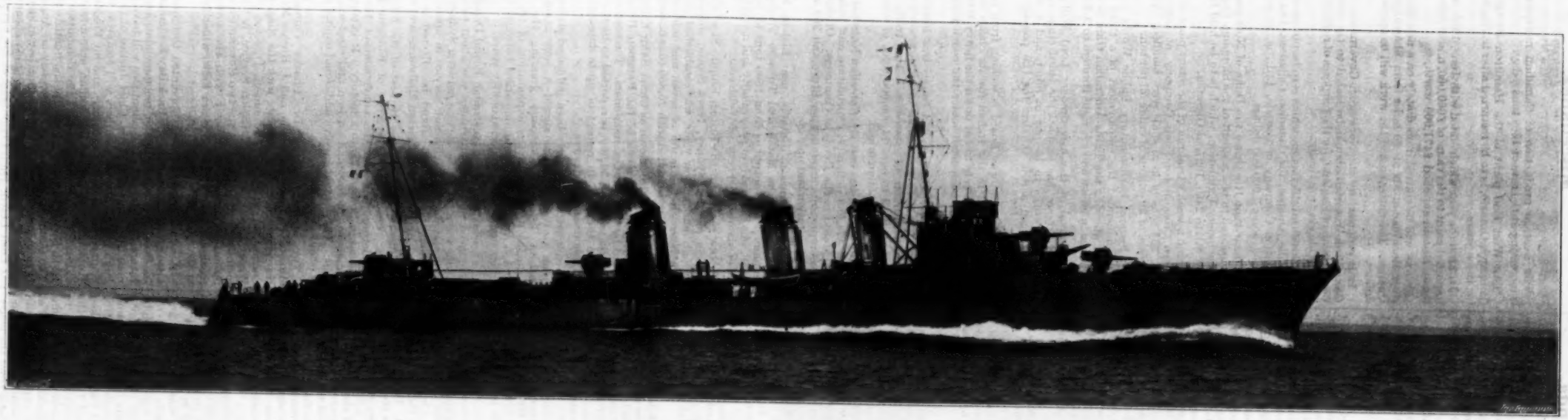
IN compliance with the request of the Shanghai merchants, the Military Governor of Kiangsu Province is considering plans for the conversion of the Kiangnan Arsenal in Shanghai into a factory. It is suggested that a chemical factory and an iron and steel works may be built. They would involve additional capital expenditure of about £500,000.

THE appointment of Dr. Charles Camsell, Deputy Minister of Mines of Canada, and J. Horace McFarland, of Harrisburg, Pa., to co-operate with the Niagara Board of Control, of which J. T. Johnson, Director of Dominion Water Power and Reclamation Service, is the Canadian member, is evidence that the two Governments concerned intend to grapple vigorously with the problem of the erosion of the crest of Niagara Falls, which is proceeding at the rate of 7ft. per annum.

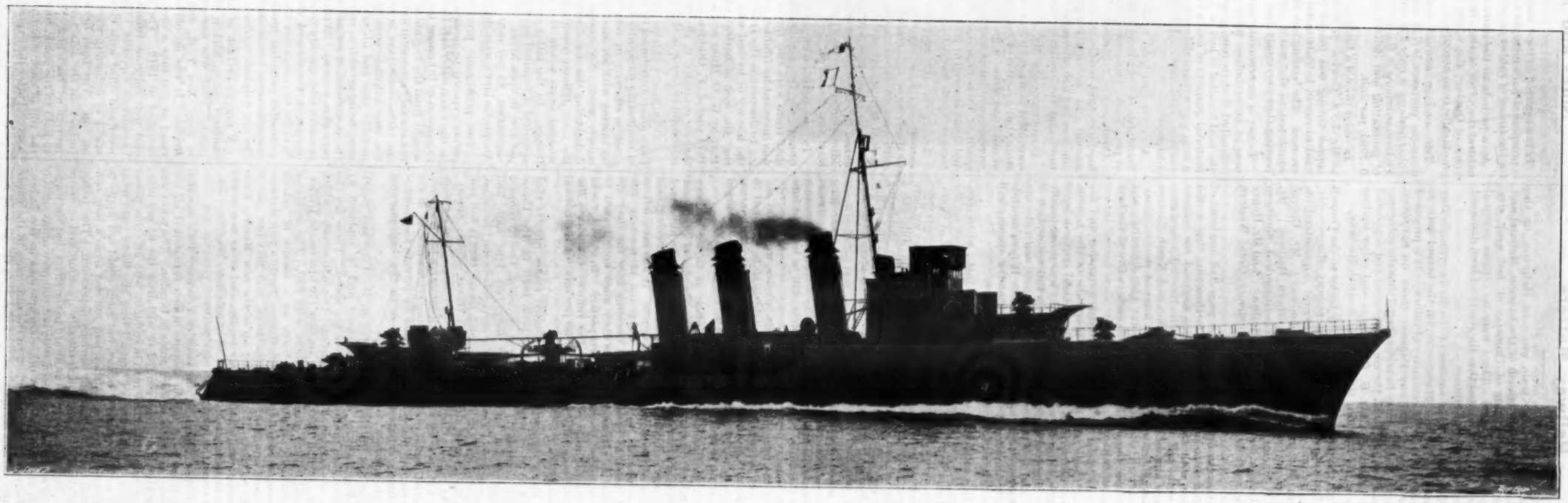
A COMMITTEE has been appointed to inquire into the history and inception of the Back Bay Reclamation Scheme in Bombay, and to make recommendations as regards future operations. The committee will have as its chairman Sir Grimwood Mears, Chief Justice of the Allâhabad High Court, and its members will comprise two eminent engineers, Sir M. Visvesvaraiya and Sir Frederick Thomas Hopkinson, as well as the Indian accountant, Mr. S. B. Billimoria. The secretary of the Committee will be Mr. R. B. Ewbank, senior member of the Bombay Civil Service. The Committee will meet at Bombay on August 2nd, and it is understood that, after the Bombay evidence has been heard the Committee will go to London to hear the evidence of Lord Lloyd, High Commissioner for Egypt since 1925 and formerly Governor of Bombay, 1918 to 1923, and Sir George Buchanan.

TWO NEW FRENCH DESTROYERS

(For description see page 84)



THE TIGRE RUNNING HER FULL POWER TRIAL



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THE ENGINEER.

JULY 23, 1926.

Naval Engineers.

So many things have demanded the attention of engineers since the opening of the general strike on May 3rd that the efforts to restore to naval engineer officers the status of which they were deprived by the Fleet Order of November last seem to have abated. Yet it would be wrong to suppose that the great engineering institutions which have taken the matter into their own hands are growing lukewarm. The check which they received when they waited upon Mr. Bridgeman has had no more effect upon their determination than the debates in Parliament. They are still firmly determined to see a wrong, in which they cannot but see a slight to the whole profession, removed, and we are confident that when the troubles in which engineers are at present involved have been surmounted they will return to the attack with redoubled energy. But even now they are not resting. The Duke of Northumberland, as President of the Institution of Naval Architects, is heart and soul with them, and in the admirable speech which he made in the House of Lords on Wednesday, July 14th, he may justly be regarded as the spokesman of the institutions. That speech we reproduce from "Hansard" at some length on another page. We reprint, also, so that both aspects of the question may be seen, the substance of the reply made by the Civil Lord of the Admiralty, Earl Stanhope. We devote a good deal of space to these speeches because they are of the first importance and because the daily papers, in a press of other matters, were not able to give to them that consideration which they deserve. We are obliged to omit other speeches, but we wish particularly to record our appreciation of that made by the Earl of Selborne, who, of all men, is most conversant with the whole problem and who shows a knowledge of the inwardness of the question and a sympathy with naval officers which we seek for in vain in the Admiralty spokesmen.

The history of the fight of naval engineer officers for status has so often been told that it is hardly necessary to review it again. It received in the debate in the House of Lords not a little attention, yet we are inclined to think that the historical aspects are now of relatively small importance. Up till 1902 the status of the naval engineer officer was very bad indeed, but in that year a scheme of common entry and training for all naval engineer officers was established. Step by step since then the old distinction, based largely on social position, between the bridge and the engine-room has weakened until to-day it may be regarded, as far as the officers themselves are concerned, as a thing of the past. But in life in a warship something more is required than a recognition of social equality, and that something was given by the military rank, which was called into being in 1915. The 1902 scheme was going or had gone, but equality was preserved by placing all officers, executive or engineer, in the military branch of the Navy. "The formation of that branch," said the Duke of Northumberland, "was due to the recognition of the great importance of engineering in a modern fleet and was a recognition of the immense services which had been performed by the engineering branch of the Navy during the war." The offence of the November Fleet Order is that it abolished that branch and all that it meant to engineers. As long as the branch was in existence engineer officers held the same kind of commission as deck officers; that is to say, an executive commission, which, as the Duke said, "is a very real thing and differs very materially from a non-executive commission." Of that commission they were deprived and were given instead a non-executive commission with which much smaller powers are associated. Moreover, this difference and this distinction between the deck officer and the engineer was emphasised "by re-imposing the purple stripe, which had been done away with for the express purpose of placing the engineer on an equality of status with the deck officer." That is really the gist of the whole matter. With practical details we need not at the moment concern ourselves. The essential point is that whilst during the existence of the military branch engineer officers held the same kind of commission as deck officers, the removal of that branch will deprive them of that measure of equality and so lower their status. It is useless for the Admiralty to aver that the order does not affect the rank, title or powers of engineer officers. It may in fact make no material difference whatever—that remains to be seen—but it unquestionably makes what, for the lack of a more appropriate word, we must call a sentimental difference. The engineer officer feels that a slight has been put upon him and he resents it. And all for what? Simply, as the Civil Lord said, to "regularise the situation." Earl Stanhope devoted a great deal of time to an elaborate examination of the meaning of "military," all with the object of showing that since everybody on a warship is a combatant, the establishment of the military branch was an anomaly. Taken *au pied de la lettre*, an anomaly it may be, but, as the Duke of Northumberland showed, it had in practice very important effects. It is the opinion, not alone of engineer officers themselves, but of all the great engineering institutions, that the inevitable effect of the order will be to lower the status of engineer officers. It is fruitless to say that the Fleet Order really makes no difference, that it simply "regularises the situation," when naval officers themselves, many of them deck officers, are quite convinced that it does in fact lower the status of engineers. In any case, if the Admiralty has no better argument in its favour, if it cannot show that some material advantage is gained by it, what object can there be in holding to the order in the face of the opposition which it has aroused?

It is clear from the reply of the Civil Lord that the Admiralty is still adamant and that the engineering institutions and all who have the improvement of the status of engineers at heart have still much hard work in front of them. We have said before and we desire to repeat here that the slight put upon naval engineers is a slight upon the whole profession. Circumstances, as we all know, make it extremely difficult for mechanical engineers to secure that recognition which by their knowledge and training is their due. It is to this great branch of engineering that naval engineers belong, and anything that touches them touches the whole body of mechanical engineers. It behoves the great institutions to press on unceasingly with their efforts, cheered by the conviction expressed by the Duke of Northumberland, "that the Admiralty will be compelled by the force of circumstances to change their attitude, because this agitation is not going to die down, but to increase."

French Economics and Trade.

DEVELOPMENTS are taking place in France which call for the serious attention of British manufacturers, who, owing to them, may find themselves in the future confronted with entirely new problems in foreign trade. Now that the French are alive to the gravity of their financial situation, they are prepared to adopt drastic measures in order to escape from their present difficulty. The methods proposed for attaining this end are rather econo-

mical than fiscal, and instead of imposing heavy burdens in the form of taxation, which, in excess, is regarded as intolerable, our neighbours prefer to embark upon a policy of restriction and economy which will enable them to meet their liabilities with the money which by that means is retained in the country. This policy implies a limitation of trade which will give results entirely different from those generally anticipated as soon as the French currency is stabilised. The proposals of the Committee of Experts are regarded as constituting the basis of the country's future economic policy. One of the recommendations is the necessity of giving a greater latitude to the law regulating the eight hours' working day. The first thing to be done to ensure national prosperity is to increase production to a maximum. That can only be effected by a readjustment of working conditions. France was the first continental country to adopt the eight hours' day, although the law was hedged around with certain reservations which would allow of its being modified without difficulty, and employers are permitted to operate for an additional hundred hours a year to make up for losses through holidays or to carry out any urgent work or for the repair and maintenance of machinery. Although the eight hours' working day is not observed so strictly as in some other countries, it is, nevertheless, held responsible for the decline of individual production and for the importation of foreign labour to compensate for the deficit at home. Immediately, therefore, the report of the Committee of Experts urged upon the country the necessity of increasing production, there began an agitation, which has been taken up by many of the Chambers of Commerce and by industrial associations, in favour of a more liberal interpretation of the eight hours' working day. So far there has been no labour opposition, although it may certainly be expected from the Communist unions. In a general way the French workman is no slave to the eight hours' day. He will work more hours in order to earn more money, and there seems to be little doubt that if Government deems it necessary, in the interests of national economy, to slacken the restrictions as regards labour, the law will not be allowed to interfere with an increased activity at the works and factories. Moreover, the law was originally passed on the understanding that it should be effective only in the event of its becoming international, but so far is this from being the case that Italy has recently adopted a nine hours' day as a means of retrieving national prosperity. An increased production, with proportionately lower costs, is therefore one factor in international trade which British manufacturers will have to take into account in the future.

Another suggestive policy which is included in the reforms proposed for readjusting finances is a restriction of consumption and a prohibition of certain foreign products which may be replaced by similar goods at home. In other words, exports must increase and imports diminish, thereby leaving a "balance of trade" in the country's favour. This policy is so firmly ingrained on the other side of the Channel that it has had to be consistently attacked by the International Parliamentary Committee of Commerce, which has not failed to insist upon the necessity of suppressing restrictions and prohibitions and of reverting to a sane policy of commercial treaties and to a greater freedom for international trade. It may, of course, be argued that the circumstances are exceptional, and may necessitate special measures, but this does not alter the fact that such restrictions and prohibitions as are now proposed are economically unsound. Nevertheless, the French firmly believe that such a policy will eventually relieve the country of its present dependence on foreign products. They are exploring every avenue of home and colonial supply. They are carrying on extraordinarily active research work, often with conspicuous success, and it seems fairly certain that France will eventually procure a very large part of her fuel, cotton, wool, grain and raw material generally at home and in the colonies, even as she is already producing more iron and steel than she requires. It is obvious that this development of national resources can only be carried out very gradually and at vast expense. If France intends to pursue a policy of restriction and prohibition until she is able to supply her own needs, the situation will be very unsatisfactory for herself, and it will necessarily practically suppress business with foreign countries. It is doubtful that the experiment will succeed, and as France can only develop her vast home and colonial resources with the aid of foreign capital, it is possible that some compromise may be effected that will favour foreign trade. This is the only way by which the virtual closing of the French market may be avoided. Again, the tendency to restriction is observable in the fiscal tariffs which will come up for debate in the Chamber of Deputies at an opportune moment. The new Tariff Bill has been continually modified during the past three years, and it has been held up solely because the fluctuating situation did not favour the discussion of a final and permanent measure. Meanwhile, it is still under the consideration of the various industrial and commercial associations, many of which have already submitted their recommendations, and when the Tariff Bill finally comes up for debate, it will be one of the most thoroughly digested schemes yet presented. It provides mainly for an entirely new classification of goods and for the payment of duties in gold francs. The tariffs all over the Continent have been increasing so rapidly that international exchanges are seriously restricted, and countries which manufacture largely for export find themselves in difficulties. In the case of France the tariffs will certainly be regarded as a source of revenue to the State. Consequently, the efforts being made to stabilise the franc will tend to an increased national production and to a restricted purchase of foreign goods.

While France endeavours to produce and manufacture everything for her own requirements, she will offer a market of less importance to British makers, unless they should be specially favoured by the conditions of competition. These will obviously depend upon the manner in which the franc is stabilised, and upon the charges which the financial readjustment will impose on industry. A too sudden appreciation of currency would be disastrous to industrial activity. This our neighbours intend to avoid as much as possible. In stabilising the situation there are risks and pitfalls which compel them to proceed with excessive caution, and meanwhile the economical situation becomes steadily worse. Experts proclaim that there can be no salvation without foreign aid. That aid the French are chary of accepting, for fear that it will place limitations on their independence. It is, nevertheless, clear that there can be no way out of the difficulty except by an international collaboration which will conduce to a gradual return to normal conditions for foreign trade.

Chemical Congress in London.

THE decision to convert the annual meeting of the Society of Chemical Industry into a Congress of the technical and other organisations connected with the chemical industries resulted in the attraction of a large number of British representatives of these industries and some foreign delegates to the Congress which opened on Monday last, and which ends to-day. Associated with the Society of Chemical Industry in the organisation of the Congress are the Association of British Chemical Manufacturers, Bio-chemical Society, British Association of Chemists, British Chemical Plant Manufacturers' Association, Chemical Society, Coke Oven Managers' Association, Institute of Brewing, Institute of Chemistry, Institute of Metals, Institution of Chemical Engineers, Institution of Petroleum Technologists, Institution of the Rubber Industry, Oil and Colour Chemists' Association, Society of Leather Trades Chemists, and Society of Public Analysts. About 800 delegates have been present.

The various sections have carried through a big programme covering a wide range of subjects. One group of papers dealt with the corrosion of metals, with particular reference to the needs of chemical manufacture; in another section the chief topic was power alcohol; a third group of papers dealt with the present position of the smokeless fuel problem; the Institution of the Rubber Industry and the Oil and Colour Chemists' Association discussed some of the problems which have arisen for solution in the paint and rubber industries; the Institution of Chemical Engineers raised the question of fat extraction by solvents; and the Bio-Chemical Society, in conjunction with the Society of Chemical Industry had before it a group of papers dealing with the scientific and industrial problems presented by the natural drugs of the body included in the hormones series.

EXHIBITION OF PLANT.

The British Chemical Plant Manufacturers' Association seized the opportunity of the presence in London of many hundreds of chemists and chemical engineers to organise at the Central Hall, Westminster, the first London exhibition devoted solely to British chemical plant and plant constructional materials. Exhibits were contributed by forty firms, and within the limits of the space available many phases of the industry were demonstrated. It was not possible to show full-scale manufacturing plants, but exhibitors endeavoured by the display of individual components and by models and drawings to give a comprehensive view, even of such plants. There is no need to describe the Exhibition in any detail, but it may be stated that it included power plant and accessories, and some of the leading producers of metals illustrated what has been achieved in the production of heat and corrosion-resisting steel and non-ferrous alloys. A special feature was made of the small-scale plant intermediate between laboratory operations and large-scale works practice, and ample evidence was given of the success with which manufacturers of plant are meeting the changing requirements of the chemical industries. Nearly the whole of the works plant and equipment for the various branches of chemical manufacture can now be obtained from British sources.

The programme has also included visits to a number of works in the London area.

PRESENTATION OF MESSEL MEDAL.

On Monday last at a meeting held under the presidency of the Lord Mayor at the Mansion House, the Duke of York, on behalf of the Society of Chemical Industry, presented the Messel Medal of the Society to Lord Balfour. It is the third time this medal has been presented, previous recipients having been Professor Armstrong and the late Lord Leverhulme.

Lord Balfour, in the course of the memorial address, which is required of those to whom the medal is presented, dealt with the relation of the State to scientific and industrial research. The policy which should be followed by a Government organisation of the character of the Department of Scientific and Industrial Research, of which Lord Balfour is the head, was, he said, very difficult to fix and could not be embodied in any set formula. The assistance to be given must depend on the particular exigencies of the moment, and the character of the problem which was being attacked, but it could be claimed that the department over which he presided had performed, in the comparatively few years of its existence, great services to the public.

It was interesting to trace out the association between science and industry. In the first stage were to be found men of genius, wholely unconnected with industry, moved only by the desire to further knowledge, possessed of an insatiable curiosity, and endowed with that special gift which enabled them to penetrate a little further than others into the innumerable secrets of nature. To these pioneers fell the glory of making those discoveries which lay at the root of our knowledge of nature. Work of this fundamental character, which was the product of genius, could not be stimulated only by education or fostered merely by expenditure. Its roots lay in deeper soil. The second stage called for the introduction of men of constructive ability who were required to show how the achievements of the pure scientist could be applied in practice. It was inevitable that obstacles had to be overcome, and that problems, not of a fundamental character perhaps, should arise for solution at this stage of progress. When these difficulties had been overcome, it was then necessary to test what had been achieved on a scale which, although larger than that of a laboratory experiment, was still far below the full-sized scale which must be the ultimate test before any scientific discovery could be directly applied in industry. Beyond that was the organisation of production in full-scale units and the marketing of the output.

That was not perhaps an entirely accurate biography of the process by which a scientific discovery became a commercial process, but it illustrated the kind of thing which happened in a majority of instances. It was interesting to ask where in that industrial evolution lay the function of the Government? A Government Department could do little to further fundamental discoveries, and should not intrude in the work of building factories or finding markets. Broadly speaking, the assistance of Government should be given in the middle region where the work was in the stage where industry as a whole and not one branch of industry was interested. With that view of the function of Government in mind, it was necessary that the officers of the Department of Scientific and Industrial Research should take a general view of world industry. If that were done he was not sure that the results of investigation would prove satisfactory to those concerned with the position and outlook of British industry. There had been no falling off in Great Britain in the achievements in the field of fundamental research. British scientists had done their share in increasing the knowledge available of the world in which we lived. When consideration was given, however, to the practical application of scientific knowledge to the great industries based upon science, it had to be confessed that Great Britain did not appear in a very good light. Many of the modern applications of science to industry had been carried to the point of success in other countries. That fact suggested that there was something wanting in the application in Great Britain of scientific knowledge to industry. While yielding to none in his admiration of the business capacity and other qualities of the great British business community and the part its members played in the economic work of the world, he would plead for a combination with those qualities

of special scientific knowledge and coupled with that the broad and imaginative outlook which was the basis of the great industries in countries with which Great Britain was in close relations not merely of friendship, but of competition. It was for those engaged in industry to remedy the present condition of affairs, and to take the fullest advantage in practice of the achievements of modern science.

Corrosion Problems.

Before a joint meeting of the Institute of Metals, British Chemical Plant Manufacturers' Association and other bodies, Mr. U. R. Evans discussed some of the fundamental principles of corrosion. He said it was now agreed by the majority of investigators that the most destructive types of corrosion were those of an indirect, electro-chemical character. Direct chemical attack on metals could indeed occur; but, except in a few instances, the direct type of corrosion was not so serious a menace, since the reaction product, being formed actually on the surface of the metal retarded the attack more and more as it accumulated. For most purposes, it was necessary to employ a material which could protect itself against corrosion, either because it yielded an insoluble body as the primary corrosion product or because it became covered with a protective film in the presence of oxygen. Most of the special corrosion-resisting materials of the self-protecting class were alloys containing one of the five elements—chromium, nickel, cobalt, aluminium or silicon. Films containing these elements appeared to lend specially efficient protection, but a tendency to failure in the presence of chlorides remained. Not infrequently the failure of the protective skin occurred at the water line, and in testing materials for resistance to corrosion, experiments with partly immersed specimens should always be included. It was rather unfortunate that nearly all the published data regarding corrosion-resisting alloys referred to wholly immersed specimens.

The action of oxidising acids was of exceptional interest. Most commercial kinds of irons and steel were unaffected by nitric acid of sp. gr. 1·42, but were attacked rapidly by acid of sp. gr. 1·20. Stainless steel with 14 per cent. chromium resisted the acid of sp. gr. 1·20, but was perceptibly corroded by very dilute acid of sp. gr. 1·033. By increasing the chromium to 18 per cent. and adding 8 per cent. of nickel, a material could be obtained capable of resisting even acid of sp. gr. 1·033. Similar relations held in the case of cast iron exposed to sulphuric acid.

Dr. W. H. Hatfield gave an account of resistant steels for chemical engineering. He said that steels were now available sufficiently resistant to a wide range of corroding media to permit of their use in many directions in chemical engineering. The experimental fact underlying that development was that if chromium was alloyed in steel of low carbon content, it would be found that when 10 per cent. was exceeded such a steel was passive when exposed to nitric acid of sp. gr. 1·20. It had been found that passivity in nitric acid was a fairly satisfactory indication of the suitability of a steel for resisting ordinary atmospheric corrosion. With the desire to extend the application of such a chromium steel to conditions where the corroding media became more complex and active, it was found necessary to modify the composition of the steel. He referred particularly to the 12 to 14 per cent. chromium steels, and steels containing approximately 18 per cent. of chromium and 8 per cent. of nickel. Such steels could be hardened and tempered like ordinary high-tensile alloy steels; the chromium-nickel steel, belonging to the austenitic class, was rendered soft and ductile by quenching from a high temperature. Those steels, particularly the chromium-nickel steel, were now being applied in the chemical industry on an extensive scale in the forms of tubes, castings, drop forgings and wire. An extensive series of experiments had been carried out to determine the resistance of the chromium-nickel steel to the corrosive action of ammonium chloride solutions under various degrees of concentration and temperature. They showed that this chromium-nickel steel was practically resistant in the heat-treated condition to all solutions of ammonium chloride at all temperatures. The resistance of the chromium-nickel steel to ammonium sulphate solutions, under numerous conditions of concentration and temperature had also been determined. It was shown that the steel was completely resistant in the "air cooled" and "water quenched" conditions to attack by pure solutions of ammonium sulphate at all temperatures. One of the most outstanding results obtained in experiments with this steel was its resistance to hydrochloric acid in the presence of sodium nitrate.

A contribution by Mr. T. G. Elliot and Mr. G. B. Willey dealt with chemically resistant steels exposed to both high and low temperatures. Reference was made to the increasing severity of the conditions which had to be met by the steel maker in materials required by the chemical engineering industries. That fact was illustrated by the processes followed in the production of synthetic ammonia. In the Haber process the pressure was 200 atmospheres, the temperature about 600 deg. Cent., whilst in the Claude process the pressure was about 900 atmospheres and the temperature about 550 deg. Cent. The synthetic production of fuel oils from gases, and the hydrogenation of solid fuel, were also problems the ultimately successful solution of which depended upon the provision of satisfactory containing vessels. Work has, said the author, been carried out to develop steels possessing the necessary characteristics at the works of Messrs. Hadfield, and it was now possible to supply steels capable of meeting a great variety of the conditions associated with high-temperature work. Various investigations had shown that at very low temperatures most metals and alloys became very brittle, but an alloy had been produced possessing excellent toughness under such conditions. At a temperature of −195 deg. Cent., the boiling temperature of nitrogen, this material under the well-known Fremont shock test, had a value of 50 KgM whereas mild steel showed only 3 KgM under those conditions. At the temperature of −195 deg. Cent., the elastic limit of this range of alloys was between 23 and 29, and the tensile strength between 41 and 48 tons per square inch. The material was of the non-rusting type, and was very resistant to cold acids. It was supplied as castings or in forged or rolled shapes, and was also readily machinable. To meet the urgent demand for materials primarily to withstand chemical attack, where very high temperatures were not necessarily in question, a highly resistant alloy had been developed.

Fuel Alcohol.

Experience with alcohol motor fuels was the subject of a contribution by Mr. J. B. Ross and Dr. W. R. Ormandy.

It was stated that the problem of utilising alcohol as a motor fuel was entirely an economic one, and that before the question could be settled it was necessary to know how a fuel for modern high-speed internal combustion engines should be valued. The factors which counted were the calorific value, latent heat of evaporation, volume ratio, the compression ratio which could safely be employed, and the tendency to self-ignition as distinct from detonation. With regard to the compression pressure which the mixture would stand, 10 per cent. of alcohol, added to petrol, would permit the same compression pressure as 20 per cent. of motor benzol. The most likely opening for the application of alcohol would therefore appear to be the addition of comparatively small quantities to ordinary petrols with a view to improving the compression. A number of tests had been carried out with the co-operation of the London General Omnibus Company to settle various points. The results obtained suggested that with petrol of a poorer grade the addition of alcohol would give a greatly improved performance. Nothing had been done to encourage the use of such a fuel, but this year the German Government had authorised the putting on the market of an alcohol-benzol-petrol mixture. Having regard to the fact that one part by weight of alcohol had twice the anti-detonating power of one part by weight of motor benzol, it was by no means impossible that a motor fuel containing small percentages of alcohol should be put on the British market.

Hormones.

An interesting discussion took place before a joint meeting of the London Section of the Society of Chemical Industry and the Bio-Chemical Society on the scientific and industrial problems presented by the Hormones.

Sir Alfred Mond, who presided at this meeting, said that what was being done as the result of the use which was being made of insulin, adrenalin, the pituitary gland and other hormones opened up a fascinating prospect to those who had passed the borders of middle age. It had been pointed out by Professor Starling, who was responsible for the discovery of secretin, that the intensive study of hormones might yield results which would not only tend to prolong human life, but might enable human beings to retain their faculties unimpaired into old age, so that they might die in possession of their full intellectual and physical powers. It was not so much a question of the preservation of old age as the retention of youth which was opened up by these discoveries.

Literature.

Mechanical Draught. By J. E. Lister and C. Harman Harris. London: Ernest Benn, Ltd. 6s. net. 1926.

This little book, which forms one of the second series of "The Chemical Engineering Library," explains in a simple manner the principles involved in the production of furnace draught, and illustrates some of the apparatus used for the purpose. In an octavo volume of 135 pages only, one cannot expect anything like an exhaustive treatment of such a subject, especially from the practical point of view, but the present work should prove useful to those who desire an elementary text-book. Nearly a quarter of the volume is devoted to the general question of the flow of and the work done in moving air. This is followed by a few pages dealing with natural draught and the principles underlying the design of chimneys. The real subject then begins, and here it is that one is tempted to criticise a certain want of judgment if not of knowledge, which appears in the choice of examples and illustrations. For example, in referring to air pre-heaters, the authors say: "These pre-heaters consist either of cast iron tubes, as in the type manufactured by Messrs. E. Green and Son, Ltd., of or narrow cells constructed of steel plate. . . ." The number of cast iron heaters in service we believe to be insignificant, and the authors do not even mention the existence of the steel tube heater supplied as a standard by Babcock and Wilcox, Ltd. Nor is the Ljüngstrom heater even referred to, in spite of the fact that it is always constructed as an integral part of the draught-producing system, and therefore has a definite claim to appear in a book on mechanical draught. A similar want of judgment is shown with regard to apparatus selected for illustration by drawings or photographs. There are in all eleven illustrations of actual apparatus, as distinguished from diagrams, and the name of one firm appears in connection with no less than seven of them. A little more credit to British makers and inventors would also not have been out of place in the section devoted to air-measuring instruments and gauges. Messrs. George Kent, for example, who have probably done more work in connection with the measurement of air than any other firm in the world, are not even mentioned, though room can be found for the name of a foreign firm, together with that of their English representatives. Although, as has been indicated above, the present volume may be read with interest and profit by those who have no previous knowledge of the subject, the book on mechanical draught for the designer or the power station engineer has still to be written.

The Elements of Motor Vehicle Design. By C. T. B. Donkin, Assoc. M. Inst. C.E. Oxford University Press. London: Humphrey Milford. 12s. 6d.

This book is intended chiefly for use of designers, draughtsmen and students. It is claimed to cover the problems encountered in the drawing-office and factory, as well as most of those in the comprehensive syllabus of the examinations in motor car engineering in the City and Guilds of London Institute. The contents include original graphs for the design of steering gear. These graphs provide a simple solution to a problem that otherwise would have to be solved by the laborious methods of trial and error. Another good feature of the book is that the majority of the worked examples apply to the same car, and for the reader's convenience a list of the leading dimensions and particulars, with cross references to the text, is tabulated in an appendix.

The illustrations have all been specially drawn to explain the text. They do not, as is so frequently the case, include copies of manufacturer's drawings, but are designs based on standard practice. Makers' drawings soon give an out-of-date appearance to publications of this kind. The chapter on "Petrol Engine Details" is very complete, but it would have been further improved if the author had gone somewhat more fully into the modern methods of piston design and construction which enable very high piston speeds to be employed. The chapter on "Brakes" contains much information of use to designers, in view of the recent developments in braking systems, but the author might have dealt much more fully with the subject, especially concerning the design of front wheel braking systems. Servo-mechanism in particular is dismissed in a summary manner. If a further edition of the work is called for, we would commend these suggestions to the author's consideration.

BOOKS RECEIVED.

Photometry. By J. W. T. Walsh. London: Constable and Co., Ltd., 10, Orange-street, W.C. 2. Price 40s. net.

Britain's Economic Plight. By Frank Plachy, jun. London: Ernest Benn, Ltd., 8, Bouverie-street, E.C. 4. Price 7s. 6d. net.

The Efficient Boiler House. By J. J. Simmons. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 5s. net.

Mechanisms. By Ewart S. Andrews. London: University Tutorial Press, Ltd., High-street, New Oxford-street, W.C. Price 3s. 6d. net.

Annual Report of the Chamber of Shipping of the United Kingdom, 1925–26. London: The Chamber of Shipping of the United Kingdom, 28, St. Mary Axe, E.C. 3.

Syllabus of the Science Scholarships Examination, 1927 (Board of Education). London: H.M. Stationery Office, Adastral House, Kingsway, W.C. 2. 1926. Price 4d. net.

The Engineering Index, 1925. Published by the American Society of Mechanical Engineers. New York: 29, West Thirty-ninth-street, U.S.A. Price, members 6 dollars, non-members 7 dollars net.

The Workman's Compensation Act, 1925. *With Notes, Rules, Orders and Regulations.* Twenty-fourth edition. By W. A. Willis. London: Butterworth and Co., Bell-yard, Temple Bar, W.C. 2. Price 15s. net.

The Association of British Chemical Manufacturers: Official Directory of Members and Classified Lists of their Manufactures. London: The Association of British Chemical Manufacturers, 166, Piccadilly, W. 1.

International Critical Tables of Numerical Data, Physics, Chemistry and Technology. Vol. I. By the National Research Council of the United States. Editor-in-Chief, E. W. Washburn. New York: The McGraw-Hill Book Company, Inc., 370, Seventh-avenue, U.S.A. Price 12 dollars.

COMBINATION TURRET LATHE

DEAN, SMITH AND GRACE LTD., KEIGHLEY, ENGINEERS

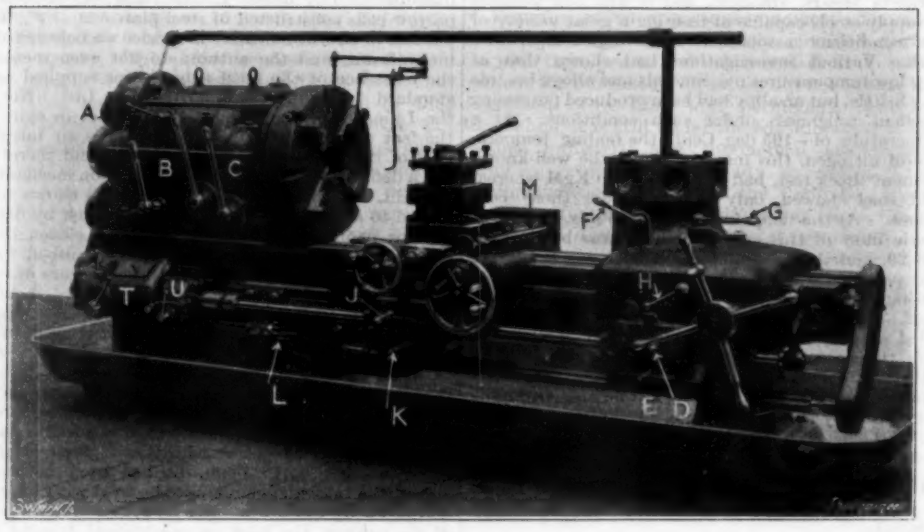


FIG. 1

Improved Combination Turret Lathe.

DURING a recent visit to West Yorkshire we were afforded an opportunity of inspecting the improved, all-geared, combination turret lathe illustrated herewith at the works of Dean, Smith and Grace, Ltd., Keighley. The lathe is equipped with a four-jaw independent chuck, 24in. in diameter, and is suitable for general chucking work. In addition, the rear end of the hollow spindle carries a four-screw bell-chuck, which is used in conjunction with the main chuck to support bars of varying diameter up to 3¼in., or, in a slightly modified design, up to 5¼in. The tool-carrying equipment consists of a hexagonal turret and an independent saddle provided with a square turret at the front and a tool post at the rear. The rear tool post can readily be removed, and in its place may be put a multiple-tool fitting, as mentioned hereafter. Longitudinal feeds are applied to each saddle and transverse feeds to the slide carrying the square turret by a spline shaft at the front of the bed. The lathe may, in addition, as shown in the general arrangement drawing—

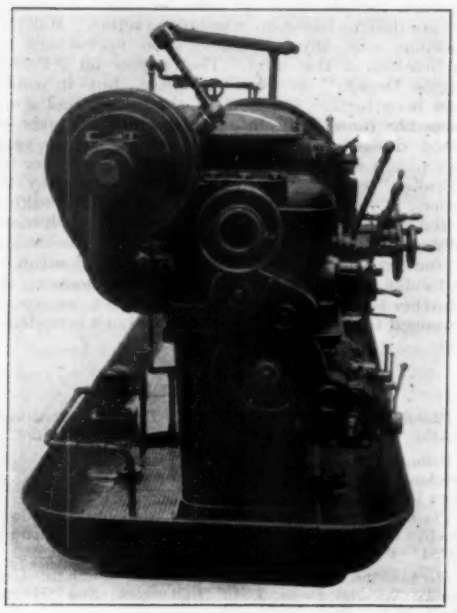


FIG. 2—HEADSTOCK END

Fig. 6—be equipped for chasing threads, in which case the saddle carrying the square turret and tool post is operated by a lead screw lying above the spline shaft.

The bed of the machine is bolted at each end to faces on the inside of a troughed base extending over the whole floor area occupied by the lathe. As shown in the end view—Fig. 2—the trough at the headstock end is provided with a sump and a belt-driven pump for the cutting fluid.

The headstock is driven by a single belt pulley running at a constant speed. A friction clutch and brake for starting and stopping the drive are embodied in the belt pulley, and can be operated by means of an overhead horizontal bar from any point along the bed. Sixteen spindle speeds are provided, ranging, for a pulley speed of 450 revolutions, from 3·19 to 343 revolutions per minute. The changes are obtained by means of four sliding gear wheels on the first shaft—operated by the handle A, Fig. 1—toggle friction clutches on the second shaft and spindle—operated by the levers B—and a pinion sliding into a wheel bolted behind the chuck—operated by the lever C. All the high-speed shafts in the headstock run on ball bearings, and the thrust on the spindle is taken on a ball thrust bearing. A pump is arranged inside the headstock to supply lubricant to the gear wheels. The design of the headstock drive renders it necessary to interlock the second lever B and the lever C. This interlocking is given by the two discs shown mounted on the spindles of these levers. The discs are formed with arcual portions removed from their peripheries and as a result neither lever can be moved unless the other is in a certain position.

The hexagonal turret slide is fitted with a hand traverse star handle. Connection for the longitudinal feed is established with the spline shaft by means of a dropping pinion operated by the handle D. This handle is held in the raised or engaged position by the trigger handle E, a touch on which leads to the disengagement of the feed. The automatic operation of the trigger handle can be secured by means of a tripping dog acting in conjunction with stops on a hexagonal bar lying below the spline shaft. This bar is geared to rotate with the turret and presents a fresh stop to the tripping dog for every face on the turret. The rotation of the turret is effected by hand. The lever F operates a locating plunger and the lever G locks the turret against rotation. The locking of the turret saddle is controlled by the lever H.

From the spline shaft feed motion is communicated to the tools on the second saddle by means of a dropping pinion controlled by the handle J. When this handle is in the left-hand position transverse feed is given to the tool slide, and when it is moved over to the right longitudinal feed is given to the saddle. As in the case of the hexagonal turret, the handle J is held in the raised or engaged position by the trigger K, a touch on which disengages the feed either transverse or longitudinal, according to the station occupied by the handle J. Automatic disengagement of the longitudinal feed is secured by a tripping dog acting in conjunction with the stops L, of which there are four, one for each tool in the square turret. A rod M carries four stops, which interrupt the transverse feed. Of the two circular wheels on the apron, that on the left gives transverse hand motion and that

FIG. 5—TURRET END OF LATHE

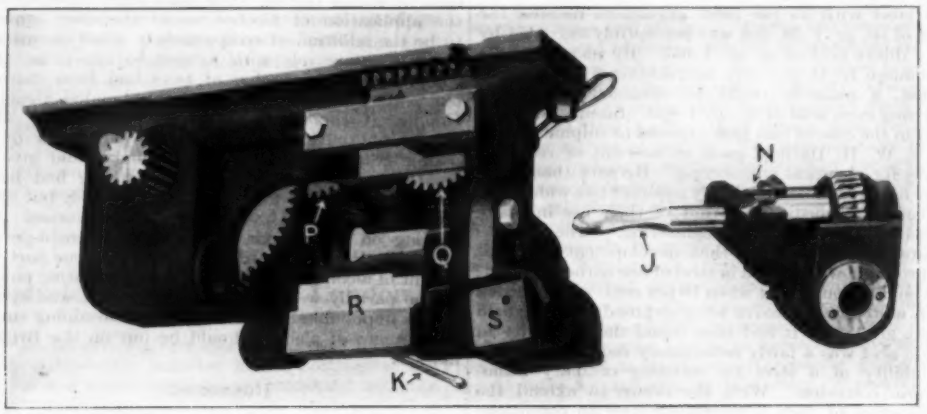


FIG. 3—REAR VIEW OF APRON OF CHASING SADDLE

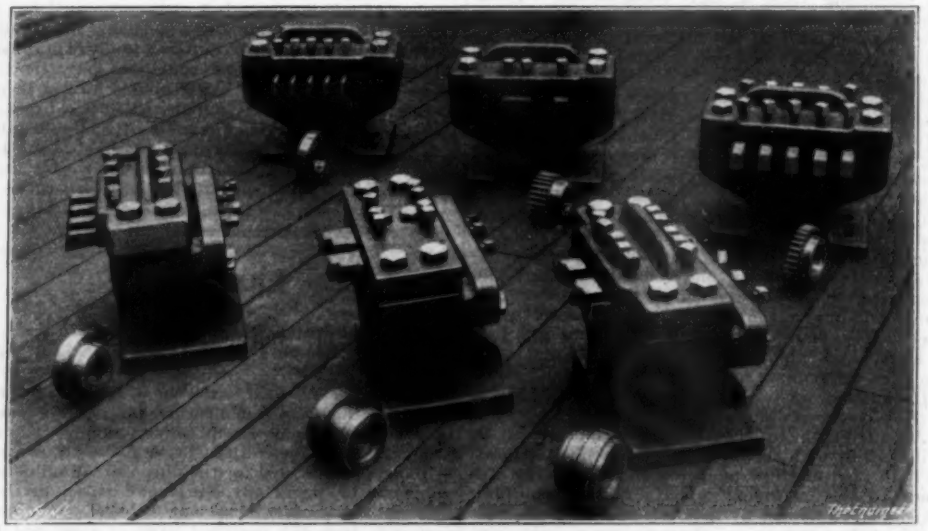


FIG. 4—MULTIPLE TOOL FITTINGS

on the right longitudinal hand motion. When the lathe is fitted with a lead screw, the feed therefrom is applied to the saddle by means of a half nut operated by the handle N, Fig. 6.

A rear view of the apron is given in Fig. 3. The handle J, it will be seen, is attached to a bracket, which encloses

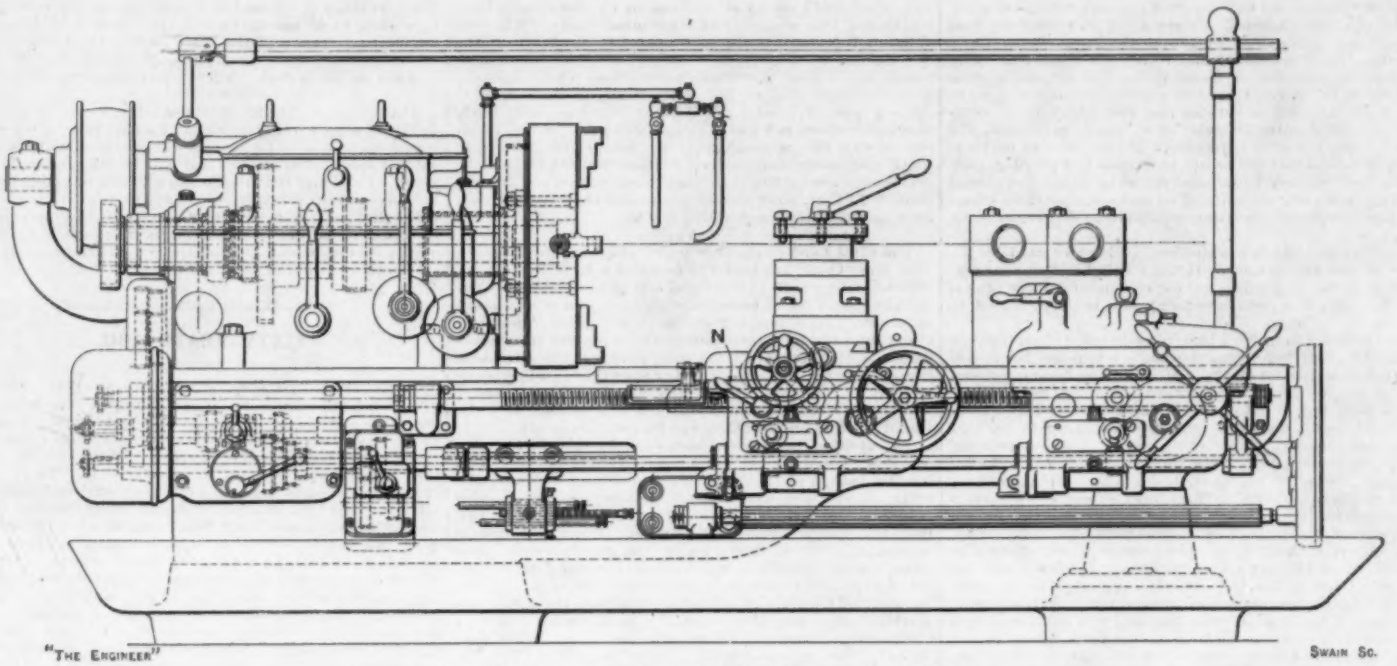


FIG. 6—GENERAL ARRANGEMENT OF COMBINATION TURRET LATHE

a worm sliding on the spline shaft. The pinion N can be slid into engagement, either with the wheel P or Q, for the longitudinal or transverse feed respectively. The bracket is held up in the engaged position by the plate R, to which the handle K is attached. This plate falls forward and allows the pinion N to drop either when the handle K is depressed or when the tripping dog S is moved by one of the stops. The engraving also shows the half nut, which engages with the lead screw and the pinion which engages with the rack. The turret saddle apron is of similar design.

The spline shaft is driven by a train of wheels from the bell chuck end of the spindle, the drive being taken first through a four-speed change gear-box T—Fig. 1—and then through a supplementary two-speed box U. The eight speeds thus provided range from 12 to 120 cuts per inch for the longitudinal motion of the chasing saddle, and from 24 to 240 for the cross motion of the chasing saddle slide and the longitudinal motion of the turret saddle. When the lathe is supplied with a leading screw, that screw is driven by change wheels from one of the shafts in the first gear-box. With each setting of change wheels, therefore, four pitches of thread can be cut. A double dog clutch in the first gear-box enables the motion both of the leading screw and the spline shaft to be reversed.

The machine requires 7 horse-power for its drive. As examples of the work done on it, we may refer to some multiple tool work, the machining of gear wheel blanks from a solid bar, which we saw it engaged upon at the time of our visit. The lathe employed for this work was of the 5½in. hollow-spindle design, but in all essential respects was practically identical with the machine we have described. Six examples of the multiple tool fitting attached in place of the single tool post to the rear surface of the chasing saddle slide are illustrated in Fig. 4. In Fig. 7 details are given of four of the examples. It will be gathered that in general the multiple tool holder carries forming tools, the square turret, parting-off and facing tools, and the hexagon turret, drills and counterboring

FIG. 7—CUTTING GEAR WHEEL BLANKS WITH MULTIPLE TOOLS

tools. In some cases the multiple-tool equipment has, we are informed, enabled the time for the work to be more than halved, while taken over ten varied forms of work the time saved has averaged 33⅓ per cent.

Royal Naval Engineer Officers.

WE briefly recorded in our Journal last week that a debate on the status of Naval Engineers was opened in the House of Lords on July 14th by the Duke of Northumberland. We now give a fuller report of His Grace's speech, with the reply made by Earl Stanhope, Civil Lord of the Admiralty.

The noble Duke said: My Lords, I have ventured to bring this question to the attention of the House because, in the opinion of those best able to judge—that is, I believe, the whole engineering profession—it will have, to say the least of it, an unfortunate effect upon the engineering branch of the Navy and very adversely affect the number and quality of those willing to come forward and specialise in naval engineering. So serious was the effect of this Fleet Order considered to be that all the great engineering societies, representing the engineering profession—the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, the Institution of Electrical Engineers, the North-East Coast Institution of Engineers and Shipbuilders and the Institute of Marine Engineers—representing 40,000 professional engineers, decided, when the Order came out, that they would draw up a memorandum of protest, which was submitted to the First Lord of the Admiralty, and a deputation was sent to represent their case to him. That shows what the opinion of the engineering profession was with regard to the effect that this Order would have.

In order that your Lordships may appreciate exactly what this Order does and what its effect will be, it will be necessary to go very briefly into the history of this question. In 1902 a system was established for the common entry and training of all naval officers, whether deck officers or engineering officers. The object of that scheme was to amalgamate the two branches of the Service to provide for interchangeability of duties, and under that scheme there was no reason why an engineer officer, if he had sufficient ability, should not eventually rise to the command of a ship. It aimed at doing away with all distinction between the executive and non-executive branches of the Navy—doing away with all distinction between deck officer and naval engineer. It did away with all difference in uniform and all difference with regard to the title of their rank. Prior to the initiation of that scheme engineer officers did not belong to the executive branch of the Navy. They had to prefix their titles with the word "engineer"—engineer commander, and so on—and to wear a purple stripe upon their sleeve. The old engineer officers who were serving prior to the inauguration of that scheme were not affected by it. It only affected officers who entered after the scheme came into force.

That scheme went on being gradually developed until 1915, during the war, when a further development took place consisting of the creation of a new branch of the Navy called the military branch, which included not only the deck officer but all engineering officers. The old officers who had been serving prior to 1902, equally with all new officers, came under that scheme. The formation of that branch was due to the recognition of the great importance of engineering in a modern fleet and was a recognition of the immense services which had been performed by the engineering branch of the Navy during the war. Between 1915 and 1921 the whole of the scheme for the amalgamation of these two branches was scrapped altogether, and a complete separation was effected between the two branches. The only thing which remained was the system of common entry. They all went in under the system of common entry, but officers who wanted to specialise in engineering had to do so on being rated midshipmen, and having once specialised in engineering they could not henceforth revert to deck duties.

Although this 1902 scheme may be said to have been completely scrapped and abolished, yet one thing did remain, and that was the military branch which had been created in 1915. Owing to the formation of that branch, engineer officers hold an executive Commission. Now an executive Commission is a very real thing and differs very materially from a non-executive Commission. An officer who has an executive Commission is commanded in that Commission to take charge and command. If, on the other hand, he belongs to the non-executive branch of the Navy he is ordered to discharge the duties of—whatever it may be, and be obedient to such as command, which your Lordships will see is a very considerable difference. There was one other thing which remained, and that was that the engineering officer still retained the same uniform as the deck officer, and there is no distinction between them in that respect.

Such was the situation at the end of last year, when the Fleet Order referred to in my motion was issued. Now that Fleet Order abolished the last vestige of the improved *status* which the engineer officer was to obtain under the

1902 scheme. It abolished the military branch altogether, and it relegated the engineer officer to the non-executive branch of the Navy. It emphasised this difference and this distinction between the deck officer and the engineer by reimposing the purple stripe which had been done away with for the express purpose of placing the engineer on an equality of *status* with the deck officer.

But we are not discussing this afternoon the merits of the 1902 scheme. Let us assume for the purposes of argument that the Admiralty were right in scrapping that scheme altogether. If we admit that, was it necessary to issue this Fleet Order and to abolish what was really of only sentimental or moral value for the engineering branch of the Navy? If you grant certain privileges to a certain category of persons and you find yourself compelled subsequently to take away those privileges, the process can never be agreeable. If you have to do that, at least you should try to insure that as few privileges are taken away as may be necessary, and also that you should give the least offence in doing so and consider the feelings of those whom unfortunately you have to deprive of those privileges.

Now an entirely new situation has been created by the issue of this Fleet Order. It has created a storm in engineering circles simply because the reason for it is not understood, and no serious argument has been produced to justify it.

The protests to which I have already referred on the part of all the great engineering societies was made because it was felt that the Admiralty's attitude had been unreasonable. A deputation was sent to the First Lord of the Admiralty, but it obtained no satisfaction. The answer given to them, and also given subsequently in another place was, in effect, that all this was a fuss about nothing, *status* of the naval engineer had not been really affected by this Order at all and that, in short, the whole grievance was merely imaginary. There may or not be a serious argument for the issue of this Fleet Order, but it is impossible to take this particular argument seriously. It is perfectly true that the career of the engineer officer who is serving at the present moment is not vitally affected by this Order. He had already been deprived of any possibility of exercising executive command on board ship, at least, in so far as fighting the ship was concerned, but the moral effect of this Order is very serious indeed.

It abolishes a distinction which was granted expressly for war services and which was a recognition, not only of the services which had been rendered by the engineering branch of the Navy but also the importance in general of engineering in a modern battle fleet. One argument of the Admiralty is that the engineer has not been any more affected by this Order than the deck officer, because the military branch is abolished for everybody and that, therefore, the deck officer ceases to belong to the military branch in the same way that the engineer officer ceases to belong to it. It is impossible to take this argument seriously either. Everybody knows that the officer whose duty it is to fight and to navigate the ship must belong to a military branch. It does not matter whether you call it the military branch or not: everybody knows that his duty is to fight the ship. It is perfectly clear that the engineer officer's duty is not primarily to fight the ship; therefore, the formation of a military branch was a compliment to the engineer himself, but was not a compliment to the deck officer. If you abolish the military branch you take away a compliment which you have given to the engineer officer and, of course, you do not affect the deck officer either way.

Moreover there is, as I say, a very vital difference in the wording of the Commission which is given to the engineer officer from the Commission which is given to the deck officer, and the distinction has been further emphasised by reimposing the purple stripe. The contention of the Admiralty in regard to the purple stripe is that it is only the same thing as the difference between two regiments, one of which wears green facings and the other yellow. One really cannot take that seriously. If that was the case, why was the purple stripe done away with at all? It was done away with in order to effect equality of *status* as between the deck officer and the engineer. If you reimpose the purple stripe it is equally clear that you do away with that equality of *status*. It does not matter what facings two different regiments wear. Everybody knows that they exist to fight. The case is entirely different between the two branches of the Naval Service, one of which does not exist primarily for the purpose of fighting and the other does.

The effect of all this has been that very great resentment has been aroused. We are told that it is only a matter of sentiment, but there are two answers to that. In the first place parents have sent their sons into the engineering branch under the implied contract that they will have a certain privileged *status*, and how greatly they resent the change is shown by the fact of the numerous letters which have appeared in the Press during the last few months. That those letters have had an effect on public opinion is also shown by the attitude of the majority of the Press in regard to this question. The best judges hold that the number and quality of those who are willing to specialise in engineering will be very seriously prejudiced. In the second place, it is a very dangerous matter to rule out sentiment in regard to matters of this kind. And are we seriously asked to believe that the sentimental value belonging to the military branch of the Navy is worth nothing at all? But, as a matter of fact, the Admiralty argument defeats itself. If all this is a fuss about nothing, and these changes do not make any difference to anybody, why do it?

Why do a thing which creates great resentment, even if it is unreasonably, in the minds of a large number of persons and unless you gain any advantage by doing it? So far as I can make out, we only lose by it and gain nothing at all. The only argument which can be taken at all seriously—and it has very little weight—is that it regularises the position and makes quite clear the separation between the deck officer and the engineer officer. That distinction has already been made because, as I say, the 1902 scheme has been scrapped altogether and, in order to make it even more clear and to emphasise the distinction, they have abolished the military branch and reimposed the purple stripe. Surely that is a red tape argument. If the division between the duties of these two branches of the Service was perfectly clear and it was understood by everybody before this Order was issued that the privileges which the engineering officer retained were merely of moral value, why should you regularise the position by abolishing certain distinctions which certainly did nobody any harm, and which the engineering branch of the Navy greatly valued?

A most unfortunate situation has been created, which will only be rendered worse by belittling it and calling it a "fuss about nothing." It is hardly likely that the whole engineering profession would have adopted the attitude it has adopted unless it had some good reasons for doing so. They feel that whatever reasons the Admiralty have for taking this step, it has been unnecessary. The distinction between the duties of the two branches of the Service was completely clear before the Order was issued, and it would seem that there was no reason for the Order at all. There was, on the other hand, every reason to "let sleeping dogs lie." As it is the dogs have been fairly aroused and are not likely to be satisfied. In the result one of two things must happen. Either the Admiralty must give some satisfactory explanation which will be acceptable about the step they have taken, or, if they cannot do that, they should reconsider the attitude they have adopted in regard to this matter.

The Civil Lord of the Admiralty (Earl Stanhope) said: This Fleet Order has been the cause of a good deal of misunderstanding both in the Press and elsewhere, and it has been exaggerated, as being an expression of a great change of policy. It is nothing of the kind. This Admiralty Order does not affect the rank, title or powers of engineer officers. It does very little more than regularise the situation already existing. I am quite aware that Lord Selborne will say: "Very well, then, why was it issued?" and I will try to show to your Lordships the reasons why the Board felt that such an Order as this was necessary.

The situation prior to the issue of this recent Fleet Order was this: There were three methods of entry into the engineering branch of the Navy. First of all, there were the older officers who were already members of the Service before the Selborne scheme was instituted. They all bore the double title—Engineer Vice-Admiral, Engineer Captain, and so on, and all wore the purple stripe. The second branch were boys who came in through Dartmouth, the seniors of whom have now reached the rank of Commander. This class of officer did not have the same title as the senior class, but instead of being called Engineer Commander, Engineer Lieutenant, and so on, they were described as Commanders (E.), Lieutenants (E.). Thirdly, there were the officers who were promoted from the lower deck. They had the double title, similar to the senior officers, of Engineer Lieutenant-Commander and Engineer Lieutenant, and they also wore the purple stripe. All these officers belonged to the so-called military branch, but, with certain exceptions, none of them exercised military command.

The result of talking of "military branch" and "military command" has been this. I believe that the genral public feel that unless an officer belongs to a military branch he is a non-combatant. That is obviously absurd. Every officer on board ship is a combatant, except the chaplain and the surgeon, and, as a matter of fact, the Navy as a whole object very strongly to the term non-combatant, because every officer on board ship undergoes the same dangers and faces the same risks.

The recent Fleet Order sweeps away this anomalous military branch, which, as I pointed out, is divided into those who held military command and those who did not, and it has divided all officers into categories according to their duty; that is to say, executive officers, who are all those who undertake duties on deck, and engineer officers, who undertake duties in regard to the engine room, accountant officers, medical officers, instructor officers, and so on. The division will not in the smallest degree affect either the *status* or the powers of the officers in question. The powers of practically all engineer officers will remain exactly as they were before the introduction of that Fleet Order. Some individuals have suggested that if an officer does not belong to a military branch he cannot hold military rank—again, these terms which muddle people outside the Service! I do not know what people mean by military rank as regards the Navy, but I do know this, that as regards naval rank the fact that an engineer officer will no longer belong to the military branch will not have the smallest effect in regard to his rank, either relatively to other officers in the Navy or in regard to officers in the Army or the Air Force. He will remain exactly where he was before.

Now I turn to the purple stripe. I think your Lordships will agree that if the engineering profession is really to be recognised in the Navy as a profession—which the Board of Admiralty wishes it to be recognised as vital to the Service and vital to the safety of this country—it is a right and it is a recognition of that service that they should bear some distinguishing mark to show that they have the honour of belonging to that Service. Other branches already have different uniforms, and I submit to your Lordships that it is absolutely essential that an officer should be distinguished instantaneously and with the greatest ease by the uniform he wears. A man no more wants to go up to a deck officer and report to him that a steam pipe has burst than to go to an engineering officer and report to him that a boat has capsized. In these days of great ships where you have may a crew of 1200 and very nearly 100 officers, it is obviously impossible that everybody on board should know every officer by sight. It is also obvious that it is desirable that when anybody comes on board a ship from another ship or from the shore, he should be able to realise whether he is talking to a deck officer or to an engineer officer, so that he may deliver his message and get on with his business with the utmost rapidity and efficiency.

All this Order really does is to regularise a situation which, as I think your Lordships will agree from the letters which have appeared in the Press, is very little understood by the public. I have tried to show that the Board of Admiralty had no sinister motive in making this Order. I have tried to show also that to have one branch of the Navy dressed in a different form of uniform and called by a different title is derogatory to that branch of the Navy and derogatory to the position which it represents; that, so far from our having tried to impose a slight on engineering, we felt that in dressing the officers of the engineering branch in a similar way we recognised them as a vitally necessary part of the Navy, and that we trusted they would become as proud of their connection with the engineering branch of the Navy as with any other branch of that great Service. We have insured that there shall be no question but that the command of a ship or a shore operation shall devolve upon a deck officer. The executive "branch" was very nearly called the executive "line" in order to show that it was the necessary chain of command. We have tried to provide that officers doing similar duties should be similarly dressed, and we left the rank, the responsibility and the *status* exactly where it was before. The last thing the Board of Admiralty, or any member of it, wished to do was to impose the smallest slight on the engineering branch of the Navy, and I trust I have succeeded in convincing your Lordships that neither in intention nor in fact does the Order do anything of the kind.

The Duke of Northumberland: My Lords, I have no desire to persist in my motion. I am sorry that my noble friend was not able to give an answer that would be considered more satisfactory than will be the answer he has given. I am sure that the Admiralty will be compelled by the force of circumstances to change their attitude because this agitation is not going to die down but to increase. I think the debate in your Lordships' House this afternoon may possibly hasten that change of attitude. I beg to withdraw the motion.

SIXTY YEARS AGO.

SIXTY years ago the Prusso-Austrian War, with its grave risk of involving other European countries in hostilities, had had a disastrous effect on the teeming prosperity with which British commerce and industry opened the year 1866. By the middle of the year the position had become gloomy in the extreme. There were numerous failures among industrial undertakings and all over the country local banks were closing their doors. In our issue of July 20th, 1866, we recorded another bank failure, that of the Birmingham Banking Company, an unlimited concern with about 800 proprietors. It was a time of something like an industrial panic. Accompanying the commercial disturbance there was, it is evident, grave disquiet as to our ability to defend ourselves on land and sea in the event of our becoming involved in war. The Prussian needle gun had, with a dramatic suddenness, established the overwhelming superiority of the breech-loading principle for small-arms. Little was known as to its construction until in the issue we have named above we gave the first accurate account of its design in a lengthy, illustrated article, based on a German source of information. In this country the impression made by the Prussians' victorious campaign had led to an intensification of the programme for the conversion of muzzle-loading Enfield rifles into breech-loaders on the Snider principle. The Government factory at Enfield had been entrusted with the conversion of, at first 20,000 and later 40,000 muzzle-loading rifles. Subsequently the Birmingham Small Arms Company was called in to assist, and it was anticipated that by the spring of 1867 at least 150,000 breech-loaders would be in the hands of the Army. It was intended to pursue the policy until not one muzzle-loader was left in the service. Developments abroad were also causing a stir in naval circles. Two American monitors, the Monadnock and the Miantonomoh, had just demonstrated the seaworthiness of this class of vessel, previously in doubt, the one by sailing round Cape Horn and the other by crossing the Atlantic to this country. It was commonly, although not universally held, that the only sure means of dealing with such vessels in a fight was to ram them. Yet there had happened within the past fortnight a mishap to a British war vessel which seemed to suggest that ramming vessels might easily suffer the worst of consequences in a ramming encounter. During a calm, clear night, apparently as a result of faulty navigation, H.M.S. Amazon, at the mouth of the English Channel, struck a small passenger steamer, the Osprey, full on the port side, and completely severed her. The Osprey sank in three minutes. Her crew, rescued by the Amazon's boats, boarded the war vessel only to find that that vessel herself was so badly damaged that in spite of all the pumps being set to work she was making water and sinking. Both crews had to take to the boats, and were eventually safely landed at Torquay. It was said afterwards that the Amazon, a new and well-appointed warship which had scarcely been twenty-four hours at sea, had not been designed to act as a steam ram. To that defence it was replied that she had the cut-water of a typical ram. In any event, that she should have been lost as a result of ramming a small passenger steamer suggested that a real ram in an encounter with a monitor might well suffer the worst of the fight. We had no monitors in our Navy at that date, and it was argued that sooner or later we would have to provide ourselves with them.

WOMEN'S ENGINEERING SOCIETY.

THE fourth annual Conference of Women Engineers will be held at Leeds University from September 3rd to 6th next, inclusive. The following programme has been arranged:—On Friday, September 3rd, at 7 p.m., there will be a dinner in the University Hall. At 7.45 p.m. members will be welcomed at the University by the Vice-Chancellor, Dr. J. B. Baillie, and the Lord Mayor will give a civic welcome. The presidential address will then be delivered by Mrs. L. A. Willson.

On the Saturday, September 4th, at 9.30 a.m., a visit will be paid to the locomotive works of Kitson and Co., Ltd., Airedale Foundry. In the afternoon, at two o'clock, at the University, a paper will be read by Miss C. Griff on "Stainless Steel and its Place in Engineering," after which Mrs. M. L. Matthews will read a paper on "Portable Electric Tools with Some Newer Developments." The annual general meeting will then be held. At 7 p.m. dinner will be taken in the University Hall, and it will be followed at 8 p.m. by a dance and social evening, at the University.

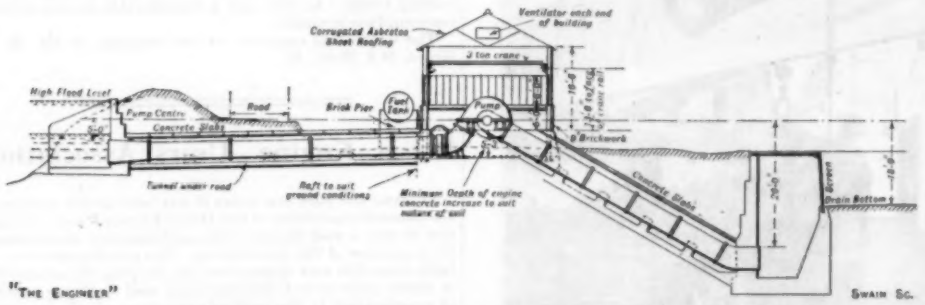
On the Sunday, September 5th, the party will leave for Halifax at 11 a.m. on a visit to Mrs. Willson's housing schemes and also to the lathe works of Smith, Barker and Willson. Luncheon will be taken at "The Jumples," by invitation of Mrs. Willson. In the afternoon a visit will be paid to Bronteland.

Burnt Fen Pumping Station.

THERE have recently been added to the pumping stations used for unwatering the fen lands of East Anglia two new plants driven by heavy oil engines. These sets, which are intended to drain Burnt Fen, which covers 16,000 acres lying between the Little Ouse and the river Lark, incidentally displace some old steam engines installed as long ago as 1842. The new pump at Brandon was set to work a year ago, while that at Lark was started on July 16th. They are similar in all respects, except that one is right-handed and the other left-hand. The line drawing given below illustrates one of the plants.

Each set comprises an oil engine, by Blackstone and Co., Ltd., of Stamford, coupled with a centrifugal pump by Gwynnes Engineering Company, of Hammersmith, together with the necessary auxiliaries. The duty is 150 tons of water raised per minute against a head of from 17ft. to 20ft.

The engines are of the three-cylinder horizontal type, and it is noteworthy that they are the first of their kind to be used for this service. They are of 250 brake horse-power each and have the makers' system of "spring injection," which facilitates starting cold with heavy fuel oil. The principle of this system of injection was fully described and illustrated in THE ENGINEER of February 27th, 1925, but it may be as well to recall that the injection of the fuel into the combustion chamber is effected by the sudden recovery of a strong spring which is compressed during the earlier part of the stroke. The oil is forced by a separate pump into the barrel of the injection pump and is imprisoned there by a non-return valve and the injection valve. The plunger of the second pump is urged forward by a strong spring that is compressed by an excentric on the lay shaft. In this way the oil in the pump is put under a heavy pressure, and when the injection valve is opened at the proper time the spring suddenly recovers and shoots the oil into the combustion chamber in the form of a very fine spray. The atomisation of the oil is in fact so thorough that there is no difficulty in starting the engine directly when it is quite cold and when



ARRANGEMENT OF BLACKSTONE-GWYNNE FEN DRAINAGE PLANT

it is running there is no knock or indication of an unduly sudden rise of pressure when ignition takes place.

In both installations the engine is directly connected with its pump through a flexible coupling of the pin type. The pumps are of Messrs. Gwynne's standard type with cast iron casings split in the horizontal plane and a cast iron double inlet impeller. The shaft is of mild steel and runs in two internal neck bearings and two external bearings carried on brackets from the main casting. The external bearings are of the ring-oiled type, with cast iron shells lined with white metal. The pump is fitted with a 42in. sluice valve arranged to be operated by compressed air, which is provided by a Blackstone two-stage vertical air compressor. This compressor is also used to charge the "bottles" for supplying the air to get the main engine under way. It is driven by a 7 horse-power Blackstone oil engine that also serves to drive the exhauster for priming the main pump.

The water for cooling the cylinder jackets is supplied separately to that handled by the main pumps and is drawn from an adjacent cooling pond by a three-throw ram pump, to be returned over an umbrella-like contrivance to help in the cooling effect. The whole of the plant in each case is housed in a steel-framed building and a hand power travelling crane is provided for removing any part of the machinery when required.

As we have already mentioned, the plant at Brandon has been in commission for a year and during that period has done 120 days of pumping, on one occasion running for seven days and five nights without a stop. Mr. J. L. Chaloner, in reporting on the running of these engines, said that :—"(1) The fuel consumption is favourably low and the total variation between consumption figures for loads ranging from overload to half-load is less than 5½ per cent. on the consumption value for full-load conditions; (2) the thermal efficiency, on a basis of brake horse-power, is over 35 per cent. for loads varying between full load and three-quarter load; (3) the mechanical efficiency at full load is as high as 85 per cent., thus only 15 per cent. of the developed power in the cylinder is absorbed in frictional and other non-productive losses; (4) the exhaust temperatures for the different loads are favourably low, thus indicating a high combustion efficiency."

It is said that the use of the new oil-driven sets will effect a saving of £1000 a year by comparison with the old steam pumping plants.

A CONTRACT has been placed by the Alloa Coal Company, Ltd., with Dron and Dickson, of Glasgow, for the erection of a plant at their Carnock Colliery capable of dealing with 3000 tons of washery silt per week. The work on this plant will proceed at once. The plant will separate the fine coal from the dirt and ash, and the coal will then be available for the coke ovens.

New Gasworks Extensions at Fulham.

IN our issue of last week we described and illustrated the new coal-handling plant which was recently completed at the Beckton works of the Gas Light and Coke Company. On Thursday, the 22nd inst., the opening ceremony in connection with a further coal-handling plant and a new gas-making installation, with a large reconstructed gasholder, was performed at the company's Fulham works by Sir Philip Cunliffe-Lister, President of the Board of Trade. The new plant comprises a complete coal-unloading, stocking and transporting installation, capable of handling up to 1000 tons of coal per day, taken from colliers at the company's Thames wharf. In the No. 1 retort house a carbonising plant with the necessary sequence of condensing, exhausting, washing, purifying, measuring and naphthalene extraction plant for an output of 7,000,000 cubic feet of gas per day has been installed, whilst an existing gasholder has been reconstructed, and its capacity increased from 2,000,000 to 4,000,000 cubic feet.

Coal-handling Plant.—In order to receive the 1800-ton cargoes, the river wall at the company's Thames wharf has been strengthened over a length of 300ft. by the driving of reinforced concrete steel piling. The piles are each 33ft. long with a cross section 18in. by 16in. In the front of the piling a deep berth for the ships giving a depth of water of about 12ft. has been constructed. This section of the work, also that of building the reinforced concrete coal bunkers, was carried out by Messrs. Saxild and Partners. On the wharf side there is a 20ft. gauge crane track, which carries two 125 tons per hour travelling and level luffing cranes, made by Stothert and Pitt, Ltd., of Bath. Each crane weighs 100 tons, and is equipped with a Barnard dumping grab of 4 tons capacity, designed for a lifting speed of 250ft. per minute. The cranes are rated for a maximum load of 7½ tons, at a radius of 58ft., and the hoist, slewing and luffing and travelling motors are 150, 30, 15 and 15 brake horse-power respectively. Behind the cranes there is a reinforced concrete hopper, 135ft. long, with a width of 38ft. and a total height of 41ft. It is capable of holding over 2000 tons of coal. The bottom of the hopper is fitted with thirteen doors, which release the coal and allow it to fall into two travelling feeders operated by a 3 horse-power motor and having three discharge rates of 80, 150 and 250 tons per hour. The coal is carried by the feeders on to a 36in. rubber belt conveyor, 180ft. long, with a designed capacity of 250 tons per hour. The first belt discharges on to a second similar conveyor belt, placed at right angles to it, travelling at 280ft. per minute, which has a total length of 570ft. and rises in two inclines from below the ground level to a maximum height of over 26ft. At the end of this belt the coal passes on to a third 500-foot 36in. belt, which runs at a speed of 300ft. per minute. A throw-off carriage is fitted to this belt, and also a travelling feed hopper, by means of which coal can be delivered to the storage ground, where it is stocked and reclaimed by a Mitchell travelling crane, built by John M. Henderson and Co., Ltd., of Aberdeen. The crane, which is designed for a capacity of about 150 tons per hour, works on a 10ft. gauge "U"-shaped track, and has a 60ft. radius. It is equipped with a 3½ ton four-wire grab lifting at a speed of 150ft. per minute, and driven by a 120 brake horse-power hoisting motor. The total capacity of the coal storage yard, assuming a uniform height of 20ft., is about 40,000 tons. All the belt conveyors, supporting gear and the stocking crane were supplied by the Mitchell Conveyor and Transporter Company, Ltd.

Coal from the conveyor which is not required for stocking or reclaimed coal is discharged at the end of the belt into two Jeffrey single-roll crushers, each capable of crushing 150 tons of "run of mine" coal to 1in. cubes. The crushers are driven by 65 horse-power motors. From the crushers the coal is again taken overhead on a 30in. wide belt of 250 tons per hour capacity a further distance of 340ft. At this point the coal can be discharged into the original belt conveyor system or it can be taken to the new No. 1 retort house by a further 24in. wide belt conveyor, 420ft. long. This conveyor rises to a total height of 90ft. to clear the roofs of the retort houses, and it has a designed capacity of 150 tons per hour, when running at a speed of 400ft. per minute.

The total distance from the coal hoppers to the end of the belt system is nearly half a mile, and the total power required to drive the seven belts is 72 brake horse-power. The coal is automatically weighed by the ship-discharging cranes, and it is again weighed during its passage to No. 1 retort house.

The New Carbonising Plant.—The new carbonising plant in the No. 1 retort house comprises two benches of Glover West vertical retorts, each with eight beds of eight retorts, or a total of 128 retorts. The retorts are 33in. by 10in. at the top and taper to a diameter of 39in. at the base. They are 26ft. in length and for 17ft. are constructed in silica. The retort installation has a capacity of 450 tons of coal per day, and a gas output of 7,000,000 cubic feet, or 35,550 therms.

Each of the coal bunkers holds a forty-eight hours' supply of coal, and the producer feed hoppers a twelve hours' supply. All coke delivered to the gas producer is automatically weighed, the coal and coke being handled by two gravity bucket conveyors, which encircle the retort benches longitudinally, and each have a capacity of 70 tons of coal, or 40 tons of coke per hour. Coke from the plant is moved by drag bar conveyors, either to the water gas plant or to a set of steel hoppers for yard trade, or, again, to a newly erected set of reinforced concrete hoppers which are designed for the rapid loading of carts, railway trucks or river barges.

The waste gases, which leave the retort settings at a temperature of about 880 deg. Cent., are passed through four Kirke waste heat boilers, supplied by Spencer Bonecourt, Ltd., which reduces their temperature to about 210 deg. Cent. By this means over 26,000 lb. of steam per hour at 130 lb. pressure and 100 deg. Fah. superheat is generated. The draught through the retort settings and the boilers is induced by steam turbine-driven fans.

The gas coming from the retort house passes in a steel main to a set of Holmes water-tube condensers, and after passing through a further set of horizontal atmospheric condensers it enters the exhauster house. In this house three Bryan-Donkin steam engine-driven exhausters, each with a capacity of 175,000 cubic feet per hour, are installed. The exhausters each have four blades and run at a speed of 78 revolutions per minute. The engines driving them are designed for an output of 37·5 brake horse-power. After leaving the exhausters the gas passes through two Cockey-Livesey type washers, and then through two Whessoe washers on its way to the purifiers.

The purifier house is a reinforced concrete structure, with overhead boxes and the oxide floor above. There are eight purifiers, each having a length of 50ft., with a width of 35ft. and a depth of 6ft. 6in. The floor of the oxide boxes is 13ft. above the ground level, and the structure has an overall area of 102ft. by 143ft. An oxide handling plant with a capacity of 30 tons per hour is in course of construction. The new purifier building displaced the works water tower, and the latter has been replaced by a tower of reinforced concrete, which has been designed by the company. It has a capacity of 60,000 gallons of water and is 30ft. in diameter and 16ft. deep, with the tank top 75ft. above the ground level. Both the purifier house and the water tower were constructed by Concrete Piling, Ltd., of London.

For the measurement of the gas made, a twin Parkinson meter of 500,000 cubic feet per hour total capacity, which is erected in a well partly below ground, has been installed.

Gasholder Reconstruction.—In the brick tank of the No. 4 holder, which was originally erected in 1850, and had a capacity of 2,000,000 cubic feet of gas, a new spirally guided holder with four lifts and a capacity of 4,000,000 cubic feet is being erected. The new holder rises to a height of 128ft., and the rise of the crown is 11ft. 6in.

The reconstruction work which we have above described has involved additions to the works electricity generating plant, both for alternating-current and direct-current supply, totalling about 1500 kilowatts. A new coke-grading plant of 70 tons in eight hours, and new coke bunkers for the water gas generators have also been erected.

Production of Iron and Steel.

ON the eve of the coal stoppage, says the National Federation of Iron and Steel Manufacturers, 147 blast-furnaces were in operation. These were reduced to 23 by the end of May, and still further reduced to 11 by the end of June. The production of pig iron in June amounted to 41,800 tons, compared with 88,800 tons in May, 539,100 tons in April, and 510,300 tons in June, 1925. Production of steel ingots and castings in June amounted to 32,800 tons, compared with 45,700 tons in May, 661,000 tons in April, and 585,400 tons in June, 1925.

The following table shows the average monthly production of pig iron and steel ingots and castings for 1913, 1920, 1922 to 1925, and the production in each month since June, 1925 :—

	Pig iron.	Steel ingots and castings.
	Tons.	Tons.
1913—average monthly	855,000	638,600
1920— " "	669,500	755,600
1922— " "	408,500	490,100
1923— " "	620,000	706,800
1924— " "	609,000	685,100
1925— " "	519,700	616,400
1925—June	510,300	585,400
July	492,700	590,400
August	444,500	477,100
September	448,700	640,100
October	473,700	652,400
November	494,100	653,800
December	503,400	606,800
1926—January	533,500	640,400
February	502,000	703,800
March	568,500	784,100
April	539,100	661,000
May	88,800	45,700
June	41,800	32,800

THE railway statistics for March last of the Ministry of Transport have recently been issued as a Stationery Office publication, price 3s. 6d. They show that, compared with March, 1925, the number of passenger journeys increased by 3.1 per cent and the receipts by 8.4 per cent. The passenger train mileage increased by 4.8 per cent. There was also a gratifying increase of 6.9 per cent. in the tonnage and of 7.0 per cent. in the freight receipts. The ton-miles increased by 6.5 per cent., and they were made with an increase of 4.9 per cent. in the freight train mileage. For the first three months of the year the passenger receipts, as compared with the first quarter of 1925, advanced 2.6 per cent., the passenger train mileage 2.2 per cent., the tonnage 1.9 per cent., the freight receipts 2.4 per cent., and the freight train mileage 2.4 per cent.

The Engines of the Union-Castle Liner "Carnarvon Castle."

ON Friday last, the 16th instant, the new twin-screw motor passenger liner Carnarvon Castle, belonging to the Union-Castle Mail Steamship Company, Ltd., left Southampton on her maiden voyage to South Africa. In more than one respect she is one of the outstanding ships of the year. She was specially designed for the South African trade and is the largest and probably the most attractive ship in that service. Her builders, Harland and Wolff, Ltd., of Belfast, have evidently spared no pains in their effort to create a pleasing and harmonious design. The two short funnels of the Carnarvon Castle with her two masts and her neatly arranged upper structures give the ship an appearance which is distinctive of the modern motor liner. Her principal dimensions are as follows:—Length, 655ft. 9in.; breadth, 73ft.; depth, 46ft. 6in.; measurement about 20,000 gross tons. Accommodation is provided for about 1500 passengers and crew, and the cabins and public rooms of the ship are excellently planned and furnished with a strong note of Dutch influence in the decorative schemes.

The new liner is designed for a sea speed of about 15½ knots and her official trials showed that she had a good margin of power and was capable of higher speeds than that at which she will ordinarily run. In designing the machinery installation full account has been taken of the most recent marine practice. The propelling machinery comprises two eight-cylinder oil engines of the Harland-B. and W. type, working on the four-cycle double-acting principle and designed for a total output of 20,000 indicated horse-power. They are some of the largest oil engines in marine service and are only equalled in output by the engines of the Harland and Wolff-built liner Asturias. The general design of the engines has already been described in our columns and does not call for further comment, but we may perhaps refer to some details of arrangement. The manœuvring controls are at the centre of the engines at floor level and are so grouped that each engine can be easily manipulated by one man. Forced lubrication is fitted, and the main-engine crank cases are totally enclosed. The main pistons are oil cooled, while fresh water is used for cooling the cylinder jackets and covers and salt water for the exhaust manifolds. The necessary pumps, filters and coolers for the various fuel, lubricating oil and cooling medium services are arranged in the two engine-room wings along with the manœuvring air compressors and starting air reservoirs. The air for injecting the fuel is supplied by twin air compressors driven from the forward end of the main crank shafts. At the after end fly-wheels with electric turning gears and Michell type thrust bearings are fitted. Forward of the main engine-room is the auxiliary engine-room, in which four direct-current generators driven by Harland-B. and W. trunk type single-acting oil engines are installed. These engines are supplied with a separate cylinder jacket cooling system. A noteworthy feature of the installation is the improved engine-room ventilation arrangements. Air is circulated through the tunnel spaces and the main and auxiliary engine-rooms by means of electrically driven fans. Although—as shown in the accompanying illustration—chequer-plated platforms are fitted, the floor plates are pierced at intervals with circular holes so that a through circulation of air can take place, and pocketing is avoided. Our illustration also shows the central air ducts and the vapour pipe connections to the main crank case, through which any oil vapour is drawn away and the oil recovered by condensation. The air intake arrangements differ a little from those adopted on the Asturias installation, in which a long air inlet manifold was employed. In the Carnarvon Castle the more usual short slotted air intake pipes are fitted. In general the engine-room is light and airy and access to it is given by an automatic electric lift connecting the engine-room with the engineers' quarters on the boat deck. The view we give also shows the overhead lifting gear, which is arranged on runways over the centre line of each engine. Brief reference may be made to the deck auxiliaries. Like the engine-room auxiliary machinery, the deck auxiliaries, including the steering gear, winches, capstan windlass, and boat gear, are all electrically operated. Electrically-driven refrigerating plant is also fitted. The ship is heated by electro-vapour radiators and ventilation is effected by electrically driven pressure fans as well as the usual ceiling and cabin fans.

TOP ENGINE-ROOM PLATFORM SHOWING VENTILATING DUCTS

Artificial Silk Factory at Littleborough.

WE were present on Thursday, the 15th inst, at the official starting up of the power plant of the new artificial silk factory belonging to British Visada, Ltd., at Littleborough, on the borders of Lancashire and Yorkshire. It is claimed by the owners that this factory is the first to be entirely equipped with British machinery. The building is one of recent construction, having been erected only a few years ago for another purpose. It is being furnished with machinery which is claimed to be capable of producing 27,500 lb. per week of the highest quality yarn of denier, ranging from 75 to 300. All the plant for this purpose is being supplied by Dobson and Barlow, Ltd., Bolton, but it is not yet completed. The power plant, with the exception of the four Lancashire boilers, was supplied by the Metropolitan-Vickers Electrical Company, and embraces some interesting features in order to obtain the most economical use of fuel for both power and process work.

The manufacture of artificial silk at this factory will be in accordance with the standard process for producing viscose silk. Sheets of wood pulp are steeped in tanks of caustic soda solution, the excess moisture being pressed out until the weight of the mixture is about three times that of the original pulp. The sheets are torn up into fine crumbs by suitable machines, and are then stored away for some days to allow a chemical change to take place. The product is then treated with carbon bisulphide in slowly revolving churns, and the resulting sticky substance is dissolved in caustic soda and water, giving a treacle-like brownish liquid, known as "Viscose." After repeated filtering processes, this liquid is forced through minute holes, about $^{4}/_{1000}$in. diameter, into a bath of sulphuric acid, where it is converted into gelatinous filaments, sufficiently strong to be pulled out of the bath by roller and to be fed into a revolving cylindrical box, where the filaments are twisted into a thread, which is laid by centrifugal action on the inside of the box. From the circular cake so formed the thread is wound into a skein. These are only some of the operations for there still remain the processes of washing drying, desulphurising, bleaching, "souring," washing, and finally drying again before the final lustrous condition is attained.

From the foregoing it will be gathered that the manufacture comprises both chemical and textile processes, and we are informed that for each 200 lb. weight of artificial silk yarn produced, in addition to the power required for driving the machinery, about 18,000 lb. of steam is needed for process work. To meet these conditions, two turbo-alternator sets have been installed, one of 1000 kilowatts and one of 100 kilowatts capacity, the larger set passing out part of its steam, and the smaller set exhausting the whole of its steam for use in the manufacturing processes. The 1000-kilowatt turbine is of the Metropolitan-Vickers standard Rateau impulse type, designed to work with steam at 160 lb. per square inch and 150 deg. Fah. superheat, but provision has also been made to permit its operation with steam at much higher conditions, such as 250 lb. per square inch gauge pressure and 250 deg. Fah. superheat, should it be decided at some later date to install high-pressure water-tube boiler plant, and thus still further increase the overall efficiency of the equipment. Branches are provided on the cylinder in two places for passing out steam at 25 lb. per square inch gauge and at 20in. vacuum, for process work. The steam which is not so required passes on through the turbine into a Metropolitan-Vickers multiple jet type condenser, which is designed normally to maintain a vacuum at the turbine exhaust of 28in.—barometer 30in. The condenser is fitted with a Metropolitan-Vickers-Le Blanc rotary valveless dry air pump and a centrifugal hot-water extraction pump, mounted on one shaft and driven by a squirrel-cage motor. The turbine drives through a set of double-helical single-reduction gearing—reducing the speed from 4500 revolutions per minute to 1000 revolutions per minute—a 1250 kilovolt-ampère, 0·8 power factor, three-phase, 50-cycle, 440-volt alternator, with direct-connected exciter.

The 100-kilowatt turbine is of the Metropolitan-Vickers back-pressure geared type, operating at a speed of 750 revolutions per minute, and exhausting the whole of its steam into a separate process steam main at 45 lb. per square inch gauge pressure. This machine receives steam at its stop valve under the same conditions as the larger machine. It is arranged to drive through double helical single-reduction gearing a 125-kilovolt-ampère, 0·8 power factor, three-phase, 50-cycle, 440-volt alternator, with direct-connected exciter. The switchgear has also been supplied by the Metropolitan-Vickers Company. In order to meet the absence of a large supply of cold water for condensation purposes, a cooling tower has been supplied and erected by the Premier Cooler and Engineering Company, of Shalford, Guildford.

A very important feature in the manufacture of artificial silk is the control of the atmospheric temperatures inside the various rooms. In order to maintain these rooms at a constant temperature, it has been found advantageous to deliver the air into them at predetermined points at a constant temperature. This problem increases in difficulty as a result of the fact that it is necessary, in order to maintain pleasant conditions for the operatives, to withdraw the foul air rising from the spinning process continuously, and provide a complete change of air once every three minutes. Usually, this air is heated by the insertion in the air circuit of a series of steam coils. Such a procedure is, however, extravagant in the consumption of heat. A scheme has been devised whereby the hot water leaving the condenser is passed into a series of Metropolitan-Vickers air heaters, where the whole of the heat required for air heating is obtained before the water passes along to the cooling tower. In this way a considerable saving in heat consumption is made.

The consulting engineer to the company is Mr. A. K. Bruce, M.I. Mech. E.

Diesel Engine Users Association.

DURING the past few years it has become the custom of the general committee of the Diesel Engine Users Association to pay a visit to one of the undertakings administered by a member of the Association. The practice seems to be both desirable and instructive, by keeping the committee in touch with recent developments and fostering a spirit of co-operation to the mutual advantage of all concerned. In furtherance of this idea Worthing was visited on Friday, July 9th. The undertaking in this town is in charge of Mr. Geoffrey Porter, A.M. Inst. C.E., one of the joint honorary secretaries of the Diesel Engine Users Association.

On arrival at the power station the party proceeded at once to inspect the plant, which is installed in connection with both alternating and direct-current supply systems. It is equipped chiefly with prime movers of the Diesel engine type with air injection. The undertaking was first started in 1901 to serve a population of 20,000 inhabitants, and the original equipment consisted of steam engines and direct-current dynamos with the usual auxiliary plant, the total capacity being 288 kilowatts. The capital outlay was then £32,500. To-day, the plant installed and on order totals 2995 kilowatts, of which only a single 250-kilowatt steam set represents the older type of equipment.

The population served to-day, including that of areas added recently by Act of Parliament and by a Special Order, approximates to 45,000, and the total capital expenditure at March 31st, 1926, stood at £218,467, of which sum £61,170 represents the cost of machinery. Loans to the extent of £79,275 have been redeemed. During the past financial year the plant generated 2,754,000 units and there were sold 2,319,000, the cost of generating per unit sold being:—For fuel, 0·44d.; for oil and stores, 0·04d.; for wages, 0·12d.; for repairs and maintenance, 0·30d.; total, 0·9d.

During the early years of the undertaking's existence losses aggregating £4668 were incurred, a sum that has since been repaid to the borough funds from the profitable working of later years. Hampered by a relatively heavy capital expenditure, by a poor load factor, by dear coal, and by much hostile criticism, progress was slow until in 1911 it was decided to take the radical step of exchanging one type of prime mover for another. Since then—apart from the experiences of war time—the undertaking has developed steadily and more particularly has shared in a high degree the general prosperity of the electricity supply industry since 1920. The policy adopted in 1911 has proved to be thoroughly sound. The Diesel engine plant has shown to be most economical, and has been found to be fully as reliable as the steam plant which it has gradually displaced. What the future has in store for this and similar undertakings time will alone show, but it seems clear that any bulk supply provided to serve the needs of Worthing and district must be delivered at a price so low as to leave a very small margin of profit to the supplier.

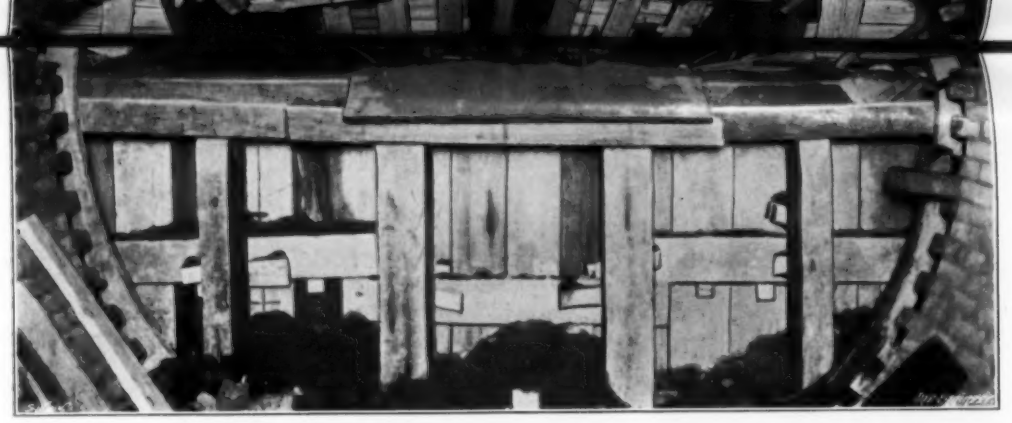
The afternoon was spent in visiting works in progress in the country districts, including 11,000-volt three-phase alternating-current transformer sub-stations supplied from the Worthing power station, and two of the Corporation's electrically driven water pumping stations. Another pumping station is in course of completion, where electricity will be the sole motive power adopted.

STAGES IN THE EXCAVATION AND TIMBERING OF A LARGE CIRCULAR TUNNEL

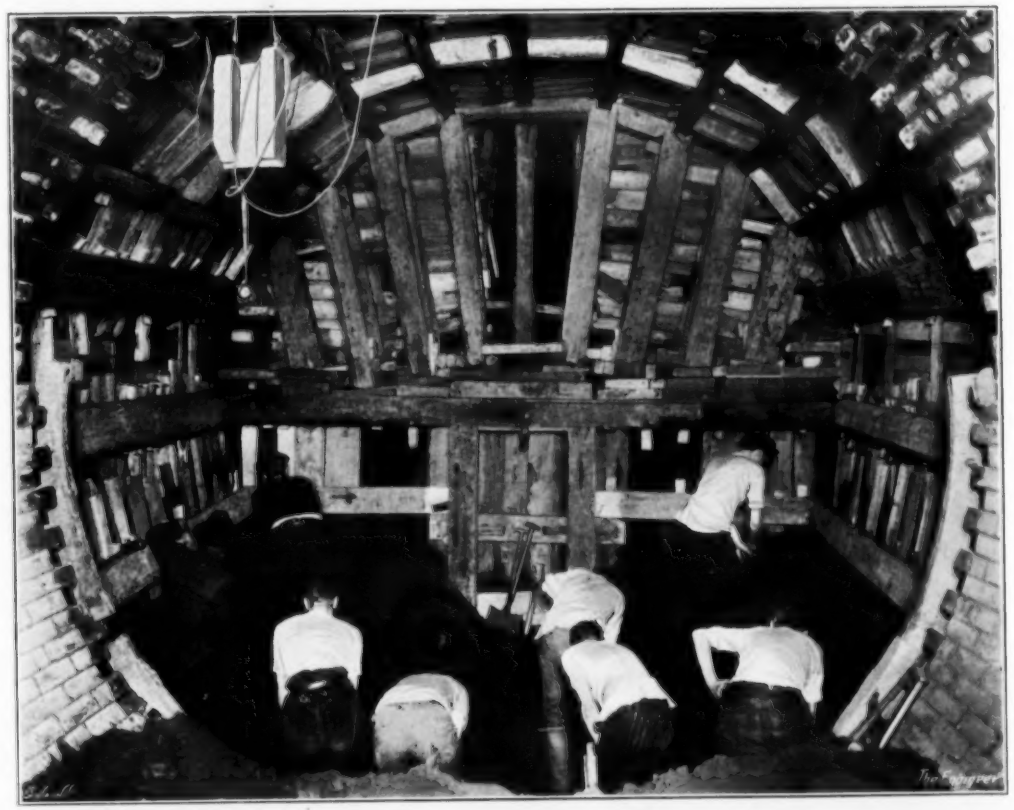
THREE BARS FIXED, POLING FOR FOURTH AND FIFTH BARS PROCEEDING

SEVEN BARS FIXED

SEVEN BARS FIXED, POLING FOR EIGHTH AND NINTH BARS PROCEEDING



NINE BARS FIXED



EXCAVATION OF LOWER HALF PROCEEDING

EXCAVATION OF LENGTH COMPLETED, INVERT FRAME FOR BRICKWORK FIXED

UNIV. OF MICH.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

THE effect of the coal stoppage in the iron and steel and heavy engineering industries of the Midlands and Staffordshire is, undoubtedly, increasing, as stocks gradually disappear in various departments. The position is likely to become critical within the next few weeks for the heavy engineering industry, while the sorry plight of most of the lighter Midland industries must continue, despite the fine fight which is being made in many factories to overcome the increasing difficulties. There is little good class fuel available, and raw materials are none too plentiful. Midland makes of all but structural steel are almost unprocurable, and additional recourse has to be had to North Country pig iron, at high prices, and continental raw steel, values of which are also appreciating.

Pig Iron.

Midland makers of pig iron are conspicuous by their absence in the market. It is a great rarity to find a small consignment of Derbyshire or Northamptonshire foundry material. Little oddments of unusual contents, which with ingenious mixing may be made to serve, are occasionally offered. Many founders who have been in the habit of using Midland brands have now to utilise Cleveland irons, which are quoted at prices increasing almost daily. No. 3 Cleveland iron lately quoted at £4 4s. has been increased to prices ranging between £4 7s. 6d. and £4 10s. at furnaces, or £5 2s. 6d. to £5 5s. delivered Birmingham. The appearance of some Shropshire all-mine has caused something of a sensation. If any consignments from the Continent are coming in, they are doing very little to relieve the shortage in local foundries. Up to the present the foundries, despite the coal dispute, have nearly all continued at work, but the position is now becoming most difficult. Trouble is being experienced in getting adequate supplies of fuel. Coke has become scarce and dear, Durham coke costing £3 5s., and Welsh coke £2 15s. delivered in Birmingham, both figures representing large increases. It is interesting, as showing the state of the raw iron industry, to note that the number of furnaces in blast at the end of June was only 11, compared with 23 at the end of the previous month, and 147 at the end of April, and that the output for the month was 41,800 tons, compared with 88,000 tons in May and 510,300 tons in June, 1925.

Steel.

Small steel-making plants in South Staffordshire continue in operation. A few of them are operated by public power services. Those dependent in any considerable degree on solid fuel are kept going mainly by outcrop coal. The production consists of strip and various specialities for local industries. Structural engineers are prepared to pay good premiums for suitable material, but the range of manufacture is very restricted. Fortunately plates, bars, and other finished steel are obtainable in small quantities from mills in other parts of the country. It is now difficult to get steel works to quote, but occasionally a manufacturer is courageous enough to offer steel at the end of the stoppage in the form of joists, sections, &c., at the current price of £7 7s. 6d. Continental steel works continue to increase their business with local manufacturers. A very unpleasant feature of the June trade returns is the large increase in imports of steel. The receipt in this country of 65,000 tons of billets against 39,000 tons in May tells its own story of the loss of valuable orders to steel works. This imported raw steel has, however, retained a good deal of business in this country, which must otherwise have been lost. Fewer continental billets are being called for at the moment, however, owing to the impotence of most of the re-rollers. A large forward contract is reported to have been recently booked at about 1s. 6d. less than the prevailing quotation of £5 9s. for mixed consignments of 2in. and 3in. billets. There is a strong demand for sheet bars from manufacturers of sheets whose plants are still running. For prompt delivery £5 15s. has to be paid. Orders have been booked for August–September delivery at half-a-crown less. Continental joists are now quoted £5 16s.

Manufactured Iron.

There is no change in the position of the Staffordshire finished iron industry. Manufacture is, practically speaking, at a standstill. Sales of odd lots from stock are still being made, generally at very good prices. Lancashire Crown bars are procurable at about £12 10s. per ton. Continental sellers of nut and bolt and fencing iron, after quoting pre-strike prices for the past month or two, are now increasing their quotations. They, however, are not so anxious for work as they were, and usually want at least a month to give delivery on a new order. Considerable quantities continue to reach this district on old contracts.

Galvanised Sheets.

Galvanised sheets are still being turned out in good quantities, mainly with the aid of foreign semi-finished material. Corrugated sheets of 24-gauge are variously quoted £16 10s. to £17 10s. Everything depends upon specifications and delivery dates. Some mills in this district are still active, and able to offer quick deliveries. The export returns just published, showing exports of galvanised sheets to the amount of about 40,000 tons, as compared with 60,000 in May, although showing a large decrease, constitute a surprising record for a strike period.

Trade Returns.

The June returns of exports and imports of iron and steel show the increasing extent to which we are dependent on foreign supplies of raw material for the saving of the trade in the present emergency. While imports last month were substantially larger than in May—233,399 tons against 166,636 tons—the shrinkage of exports was accelerated, the tonnage falling to 231,334, as against 273,750 tons in May and 330,664 tons in January last. The total for the first half of this year was 1,900,814 tons, value £32,301,158, against 1,831,416 tons, value £34,086,610 in the first half of last year, and 2,024,417 tons, value £38,843,562 in the corresponding period of 1924.

Rolling Stock Orders.

Satisfaction is expressed that the portion of the orders for 200 first and third-class passenger coaches and all-steel luggage brake vans required by the London and North-Eastern Railway Company, which has come to Midland rolling stock establishments, is so generous. The firms with which contracts have been placed include the Gloucester Railway Carriage and Wagon Company, Ltd.; the Metropolitan Carriage, Wagon and Finance Company, Ltd., Birmingham; and the Midland Railway Carriage and Wagon Company, Ltd., Birmingham.

Nut and Bolt Industry.

The Black Country nut and bolt works continue in operation. Many of them rely almost wholly upon oil for heating, and using continental raw material, they are making remarkably good output under coal strike conditions. The railways are still placing orders for track material, and works order books insure continuous operation for some little time to come.

The Mining Situation.

The desire of miners in the Midlands to return to work under the owners' last offer, including the eight-hour day, is growing, and each day sees a more general return to work at the pits in this area. The owners, especially in the Warwickshire coalfield, are doing all they can to get the men back, and this week have given an assurance to those who have returned that no victimisation will be allowed to take place. It is estimated that fully 3500 miners have now resumed work in this area. At Pooley Hall the full complement of about 800 are still working, while the figures given for some of the other pits are as follows:—Arley, 740; Tunnel Colliery, 364; Griff No. 4, 129; Griff Clara, 104; Birch Coppice, 260; Kingsbury, 300; Haunchwood, 310; Baddesley Collieries, 287; Tamworth Colliery Company, Ltd., 360; whilst a fair number are also at work at Newdigate, Gaddesby and other pits. In the Cannock Chase coalfields more miners are returning. Six hundred and fifty are at work at four collieries in the district, and many more are said to be signing on.

Pit Mound Coal.

Hundreds of miners on strike from the pits are reaping a nice income by working up old mounds, and exploration has now extended to canal wharves, where very useful stocks of coal have been recovered from the bottom, generally of good quality. This coal and slack has enabled many Black Country works to supplement their fuel supplies, and maintain a certain amount of re-rolling. For actual steelmaking this sort of fuel is, of course, of no value, and the big Midland works are still at a standstill.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

WHATEVER may be the facts regarding the gradual drifting back of labour to the coal mines in various parts of the country, there has, up to now, been no such movement in connection with the collieries of Lancashire and Cheshire. The effect of the stoppage is becoming more and more pronounced in the case of the engineering industries. Manufacturers of heavy electrical plant are perhaps the best situated, both from the point of view of work in hand and their ability to continue operations on something approaching a normal scale. Textile machinists and machine tool makers, however, are indifferently employed, and other branches are suffering more from the difficulty of securing iron and steel and coal than from the actual state of the demand. Sir Percy Woodhouse, the President of the Manchester Chamber of Commerce, summed up the position of the engineering industries in his address at the half-yearly meeting of the Chamber this week. Before the coal dispute commenced, he said, there were encouraging signs in respect of almost every branch of engineering; the shipbuilding programme alone gave promise of work for all sections. At present orders were naturally being withheld pending a settlement, and the iron and steel foundries were rapidly coming to a standstill. Manufacturing engineering, in whatever branch, was bound to feel a time-lag of several weeks, even when the collieries were open again. "The tragedy of it is," said Sir Percy, "that according to information which reaches me there is a greater volume of potential business in several branches of engineering than for some years past. That leads one to hope that as soon as the coal cloud can be lifted the engineering industries will be able to make real progress providing the delay in settling the dispute is not so prolonged as to result in our foreign customers going elsewhere for their requirements."

Textile Machinery for Russia.

The statement of Mr. S. J. Emdin, representative of the Russian Textile Syndicate, regarding the purchase of textile machinery in this country for shipment to Russia, confirms to some extent the information given in this column a fortnight since, with reference to probable further orders to be placed with Lancashire textile machinists. Mr. Emdin states that, in addition to contracts previously placed in this country in May and June alone, orders for textile machinery and accessories to the value of £666,705 were placed by the technical department of the Syndicate. During the last three months the Syndicate has shipped direct from Manchester to Leningrad or Murmansk 4500 tons of machinery, the last cargo, consisting of 1271 tons, being shipped at the beginning of the present month. According to Mr. Emdin, it is proposed during the financial year 1926–7 to place in England orders for materials, including machinery, to the value of between £10,000,000 and £11,000,000, although as to actual orders placed, much will depend upon the credit terms offered by manufacturers here.

Non-ferrous Metals.

The copper market has been interested in the cabled extract from a report of the Washington correspondent of the *New York World* regarding the Copper Export Association, which should have started to operate at the end of last month, but whose operation was postponed until the end of July. The report in question asserts that under the guise of an export association there is being formed what appears to be an international copper trust, comprising 90 per cent. of the world's producers of the metal. Stress is laid on the fact that the project has still to run the gauntlet of the United States Federal Trade Commission. In the meantime, the market for copper, helped by fairly good buying on American account, has kept very steady, and on balance present quotations for the metal show a further improvement on those ruling a week ago. The statistical position of tin remains very strong, and with sellers firm, values now current show a further substantial improvement. The demand for lead from continental consumers has expanded, and prices have advanced in consequence. Spelter is also much firmer than it was at this time last week, and shows signs of continued strength.

Iron.

With few blast-furnaces operating in any part of the country, offers of pig iron are very sparse, but for what there is to be picked up, the demand is anything but keen, for prices are too high to afford attraction to any but the most needy users. Many of the latter are more troubled by the fuel difficulty than that resulting from the iron famine, and in not a few instances have had to close down altogether, whilst others have been compelled to reduce operations. Midland counties makes are still entirely absent from the market, and are likely to remain so while the coal dispute goes on. The only irons that are available, and these in very limited quantities, are Scottish No. 3, which has again made its appearance this week at prices varying from 100s. to 102s. 6d. per ton, delivered Manchester or equal, with Middlesbrough No. 3 at about the same figures, and West Coast hematite at about 94s. per ton. None of the makers of bar iron are producing yet, and have not done so in most cases since the beginning of the general strike, although merchant stocks are still available. The fixed prices for Lancashire bars remain at £11 10s. for Crown quality, and £10 5s. per ton, delivered in this area, for second quality bars. The demand for these, however, is still on a quiet scale.

Steels.

As before, virtually the only business that is being done in steel is in respect of continental makes, for which a quietly steady demand is being experienced on the Lancashire markets. For delivery to buyers' works in the Manchester area, for cash against shipping documents, continental steel bars are now offered at about £5 15s. per ton, ship plates at £5 17s. 6d. to £6, Siemens plates at £6 7s. 6d. to £6 10s., sections at £5 17s. 6d., and joists at £5 12s. 6d. These prices are for direct shipment from the Continent, delivery taking from four to eight weeks, according to the nature of the specification. One or two of the re-rolling mills in the Lancashire area are working at a reduced rate on foreign fuel, and for mild steel bars these are asking from £9 to £9 10s. per ton delivered. Other quotations, under existing conditions, are purely nominal at £7 7s. 6d. per ton for joists and sections, £8 2s. 6d. for ship and tank plates, and £11 10s. for boiler plates. Makers this week report further additions to the orders for steel material already held and awaiting execution when conditions return to normal. Several galvanised sheet mills have re-started, but their outputs are much below normal. The export demand for these continues quiet at up to £16 10s. per ton f.o.b. Wasters are selling fairly freely at about £15 10s. per ton, although these are becoming offered on a reduced scale.

Scrap.

Iron and steel scrap is still very dull, and prices remain purely nominal. Non-ferrous scrap is also quiet at £39 10s. per ton for brass rod turnings, £52 for gunmetal, £48 for brazierv copper, £61 for heavy copper scrap, £25 for zinc, £31 for lead—these prices being for graded qualities, delivered to users' works.

BARROW-IN-FURNESS.

There is nothing fresh to report with regard to the North-West Coast hematite iron and steel trade. There is a little business being done with the remaining stocks, which are gradually being reduced to zero. All the ironworks are idle, and there is no activity, except in the hoop works at Barrow, where Belgian billets are being rolled. In the shipbuilding and engineering departments of Vickers Ltd., there has been no interference by the coal strike, and this firm is assured of a continuous run of activity. The cruiser Cumberland is gradually taking shape at the fitting-out wharf, and her funnels are in, but up to the present her guns have not been put in position, nor has her mast been stepped. The news that Vickers are proposing to build the M.A.N. double-acting internal combustion engine is interesting, but it is not a surprise, for rumours have been about for some time. Vickers themselves years ago experimented with the double-acting principle with a single-cylinder, but nothing followed, and up to the present they have always installed the four-cycle engine which bears their name. The success of the M.A.N. engine has already been proved, and much interest attaches to the 15,000 horse-power engine installed in a German power station built by Blohm and Voss. The motor ship Magdeburg, which has the new M.A.N. double-

acting engine, has had a most successful run up to now, having completed a 23,000-mile trip, when she gave a speed above her guarantee. It is hoped the adoption of this design of engine by Vickers will lead to increased activity locally.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Improves.

THE effort to put an embargo on coal has completely failed in this district, with the result that more plants are preparing to restart, including some which at the outset of the dispute decided that it would not be worth while to put up a struggle. Events have worked out very differently from what most people imagined. The majority of the big engineering firms have now got a proportion of their plants going, and in a few cases, indeed, overtime is actually being worked. Production costs, of course, have moved up sharply, but, even so, manufacturers believe that on the whole they will be able to meet the position with every reason for satisfaction. There is no shortage of orders in the special steel departments, and the forges and rolling mills are thundering away all along the East End route in a manner which is little short of remarkable, when one remembers that the coal dispute has now lasted nearly three months. It is at least a strikng tribute to the vigour and enterprise of Sheffield industry. The mills that are driven by electric power from the Sheffield Corporation station have experienced no interference in the supply. The possibility of any interference, too, is remote, for it is reported that the department has enough fuel to carry on for five or six weeks. German coal is being used, and it is not anticipated that the supplies of electricity will have to be rationed. "We shall certainly not do so unless the dispute continues for an abnormal period," is the statement by an official of the undertaking. The statistics of steel production for May have been published recently, and the details for the Sheffield area show the extent to which the dispute has hit this branch of the trade. In this month only 11,900 tons of steel were made instead of about 90,000 tons, the approximate recent monthly average. The following are the details of the May output:—Acid, 5800 tons; basic, 2600 tons; acid Bessemer, 600 tons; other kinds of steel and steel castings, 2900 tons. The figures will, no doubt, be even less for last month. In the Lincolnshire area during the same period about 40,000 tons of steel should have been produced, but the actual output was only 2600 tons. In view of this heavy drop, it is only natural that users have been looking to the Continent for supplies, and a good many mills are now running on French and Belgian billets, but for the supply of which they would have stopped. The imports for last month of billets, rolled iron, wire rods, joists, girders, plates and sheets, hoops and strip, and steel, sheet and tin-plate bars, total 32,000 tons more than in June last year.

Increasing Coal Supplies.

The Sheffield district is exceedingly fortunate in its rich supplies of outcrop coal. Much of it lies in the very centre of the industrial area, and though a good deal of it is poor stuff it serves its purpose when mixed with better quality fuel. These outcropping seams are being found all over the district, and though some have been stopped by the owners of the land where damage is being done or a dangerous plan of working followed, the majority are developing on a rapidly increasing scale. Mr. G. C. Brooks, the coal controller for Sheffield, estimates that no fewer than 50,000 men who would otherwise be unemployed, are being kept at work by coal which is being got from Sheffield outcrops. This coal, he adds, may be the salvation of Sheffield. Many hundreds of men are working on the outcrops, the majority being miners, as can be judged by the expert manner in which they run their shafts and use props, and it is significant that they have no objection to working an eight-hour day. In fact, in one case, in which the owner of a field has struck a 7ft. seam of good quality Silkstone coal, and has run thirteen shafts in the hillside, his trouble is to find accommodation for the great number of miners who have come from all over the district to get work there. It is estimated that the output is more than a ton per day for every man employed on outcrops in the city. In one case, in Darnall, which is in the heart of the East End of Sheffield, 500 men are employed on a miniature coalfield. Work is continued throughout the night by the aid of lights from candles and small fires, and by morning huge stacks of coal, in some cases over 10ft. high, are ready to be transported. A good deal of continental coal, too, is coming into this district, and the Sheffield Chamber of Commerce, acting on the advice of the Association of British Chambers of Commerce, has given prominence to the announcement that it may not be generally known that there is no restriction whatever upon the amount of foreign coal which any firm or individual may acquire or use.

More Orders for Railway Work.

Orders for 200 first and third-class passenger coaches and all-steel luggage brake vans have been placed within the last fortnight or so by the London and North-Eastern Railway Company, and I have already referred to several of the firms which will participate in this work. Another firm to benefit is the Clayton Wagon Company, Ltd., of Lincoln, from which have been ordered a Clayton railway steam car, two trains, each consisting of two quintuple units, and ten third-class bogie carriages. This company has also received the orders for:—Forty-one four-wheeled goods vehicles for the Tanganyika Railway Company, a number of large bogie tank wagons for the South African Government Railway, and a Clayton railway steam car for the Egyptian State Railway. The steam cars referred to in these orders will be similar to that supplied some time ago to New Zealand.

Tools, Plate, and Cutlery.

The lighter trades are finding it an easier matter to carry on than the heavy, and therefore larger power-consuming, branches. The tool trade, in fact, is fairly brisk, and, judging by the returns for June, the export trade is satisfactory when all the difficulties of the situation are taken into consideration. The loss on the half-year by comparison with the returns for the correspondng six months in 1925 is about £200,000. During last month the saws, edge tools, rasps and files that were exported totalled approximately 2,000,000 articles, which is not greatly below the number for the previous June. Engineers' and garden and farm tools recorded a decline, but not a serious one. In the plate and cutlery trades there is little that is either fresh or encouraging to report. It is true that the exports of cutlery are being well maintained, but the profit on this work is very small, and the home trade has fallen away considerably. Even the large catering establishments are showing extreme caution, and in this and many other directions can be seen the effect of the coal dispute on the general trend of trade. The Cutlers' Company of Sheffield has been very vigilant of late in its efforts to check the unfair practice of marking cutlery and electro-plate made abroad in such a way as to give buyers the impression that it has been made in Sheffield. Following a series of complaints, the Federal Trade Commission of the United States has issued orders against eleven manufacturers of silver plate ware in order to put an end to the illegal use of the name of "Sheffield" on goods. The firms concerned have been ordered to discontinue the use of the name "Sheffield" to describe silver not made in Sheffield, England. This is an important step towards the abolishment of false marking, which has done greater damage to Sheffield trade and reputation than people outside the trade realise. There are still many anomalies and unfair practices in the marking of merchandise, but the Cutlers' Company is keeping a watchful eye on all these happenings.

Industrial Area Planning.

Two further parts of the Chesterfield region planning scheme have been issued dealing with industries and industrial development, and with the Rother and Doe Lea valleys and their development. The growing importance of Glapwell, Holmewood and Williamthorpe collieries suggests the planning of an industrial area in the Doe Lea Valley, west of the position where it is crossed by the Mansfield road. The working out of the coal seams in the Clay Cross area and the importance of Clay Cross itself would seem to point to the advisability of gradually building up a group of industries somewhere adjoining the Midland Railway, and the Derby road. This area was put forward by the Electricity Commissioners as being suitable for a generating station for the district.

Fuel Research Difficulties.

Fuel technologists have been interested in the applications which came before Mr. Justice Eve last week and his sanctioning of a scheme of arrangement involving a reduction of capital in connection with three companies—Low-temperature Carbonisation, Ltd., Gas and Plants, Ltd., and the Barnsley Smokeless Fuel Company, Ltd. A petition was also entered for the compulsory winding up of the Low-temperature Carbonisation Company. For the three petitioning companies, it was stated that they were pioneers who had sunk all their money and were just in sight of possible success, which would be entirely destroyed if the assets were sold to new people. In round figures the loss is a million pounds, and it was pointed out that the three companies had been closely allied in the research work that had been done. The scheme was sanctioned and no order was made on the winding-up petition.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Position.

THE twelfth week of the coal stoppage sees industry in the North of England in a precarious condition. Increasing quantities of foreign fuel are being imported, and many undertakings which otherwise might have had to cease production are thus enabled to continue operations. Nevertheless, the position of the major part of industry remains serious, and certainly worse than a week ago. Two of the six blast-furnaces that have been kept in operation on the North-East Coast since the general strike have been put out of blast, and a few more steel furnaces have been allowed to die out. Most of the engineering establishments, however, are still grappling successfully with their difficulties, and the importation of a large quantity of foreign plates and sections has enabled operations to be resumed at one of the shipyards on the river Tees. What is usually regarded as the quietest period of the year for industry has been entered upon, and the most favourable turn of events could not inspire hope of restoration of normal conditions before the autumn. Even when ample home fuel supplies are once more coming forward, some weeks must elapse before a general resumption of operations can be made at the iron and steel works.

Cleveland Iron Trade.

The position in the Cleveland pig iron trade shows no material change from last week. Business still rules in narrow limits, owing to the acute scarcity of iron, and so it must continue until it is possible to get the wheels of industry moving again. Makers' stocks are sold, merchants' holdings are trifling, and the only iron available for the open market is a portion of the output of the two blast-furnaces that remain in operation. It is encouraging to observe that traders are still optimistic regarding business prospects when the miners get back to work, and it seems fair to assume that a good volume of orders is banking up for fulfilment later on. But producers are not accepting post-strike orders indiscriminately, although plenty are being offered. There has been a certain amount of foreign material bought, but continental prices are advancing, and another difficulty is the delay in obtaining delivery. Hence, consumers are prepared to pay the price for Cleveland pig iron if they can get it. Prices are unchanged from last week, No. 1 Cleveland foundry iron being 90s., No. 3 G.M.B. 87s. 6d., No. 4 foundry 86s. 6d., and No. 4 forge 86s. per ton.

Hematite Pig Iron.

Now that the number of East Coast hematite furnaces still operating has dwindled to two, there is a prospect of an increasing scarcity of this class of iron also. Hitherto, it has been comparatively freely obtainable, but some firms have now only special grades for disposal, and whilst stocks are still available at other works the supply is by no means inexhaustible. Mixed numbers are firmer in price at 81s., and No. 1 at 81s. 6d. per ton.

Ironmaking Materials.

Business is utterly stagnant in the foreign ore trade. Best Rubio ore is still nominally quoted at 21s. 6d. per ton, c.i.f. Tees. There is no coke on offer.

Manufactured Iron and Steel.

So far as can be judged from the inquiries circulating, there is a good demand for manufactured iron and steel, but the fact is that buyers are questing far and wide in the hope of covering pressing needs. There is, however, very little material for disposal, and the inflow of foreign supplies is also interrupted by labour troubles abroad. Nominally, steel ship plates are £7 17s. 6d. per ton, but rolling has ceased, and makers have only odds and ends to sell. However, the galvanised sheet mills, using very little coal, have been able to keep going, and can readily dispose of all their output at £16 10s. to £17 per ton. Black sheets are at £11 per ton.

Huge Bridge Bearings.

The feat of removing one of the four bearings for the new bridge across Sydney Harbour from the works of the Darlington Forge Company to the Middlesbrough docks for shipment was successfully accomplished on Sunday last. The contract for the construction of the bridge is in the hands of Dorman, Long and Co., Ltd., of Middlesbrough, but the bearings are being provided by the Forge Company. These bearings are made of steel castings and forgings, and each of the four weighs over 300 tons. The bearings are designed to carry the bridge across Sydney Harbour. Two will be erected at each side, and the main span of the bridge will rest upon them. The bridge has a span of 1650ft., and will be the largest one-span bridge in the world. The nearest approach to it is at New York, where the length of the span is 976ft. The approaches to the bridge are not, of course, included in the measurement of the span. A main road, two lines of railway, and two footways are provided on the bridge. Seventeen special wagons were provided by the London and North-Eastern Railway Company for the conveyance of the parts.

Cleveland Miners' Wages.

As the result of the increased selling price of pig iron during the past quarter, the wages of Cleveland ironstone miners were this week advanced by 3 per cent. Only one mine is, however, in operation in the district.

SCOTLAND.

(From our own Correspondent.)

The "Fair" Holidays.

THE annual holidays are now being held, and those works which have been able to maintain employment, despite the industrial trouble, are at a standstill meantime. Under present conditions the stoppage may be somewhat prolonged.

Steel and Iron.

The continuance of the coal stoppage has resulted in the closing down of all the steel works. The amount of orders for delivery after the termination of the strike shows a fair tonnage, but might have been greater but for the caution exercised by sellers in view of the uncertainty of the future cost of raw materials. Buyers have been endeavouring to cover requirements, and some good tonnages have therefore, of necessity, gone to the Continent. Having completed arrangements for supplies of fuels two or three of the bar iron works will restart operations almost immediately. Pig iron prices show a further rise and a continued upward tendency.

Yarmouth Bridge Contract.

It has been reported that Sir William Arrol and Co., Ltd., Glasgow, have received the contract for the reconstruction of the Haven Bridge, Yarmouth, at a cost of £162,062. It is also reported that two West of Scotland firms will participate in a number of orders placed by the London and North-Eastern Railway Company for passenger coaches and all-steel luggage vans.

Arrivals of Foreign Fuel.

Large cargoes of coal still arrive regularly in the Clyde, and it is stated that supplies from America, Germany and Belgium are expected up to September. Since May upwards of 50,000 tons have arrived, and before another two weeks have gone, that total will probably have been doubled. Edinburgh Town Council Gas Committee has just decided to purchase another 7000 tons of fuel from America. Bo'ness Harbour and Dock are busy with the unloading of foreign coal, five steamers having arrived from Hamburg and one from Ghent. The total amount of the cargoes is 10,000 tons.

Bunker Coal Prices.

Quotations for foreign coal for bunker purposes show an increase at the following levels:—Silesian screened, Westphalian screened, and American unscreened, all 47s. 6d.

per ton f.o.t. Glasgow. Scottish patent fuel is approximately 40s. per ton f.o.b. Glasgow. Prices at East of Scotland ports are almost similar, with the exception of patent fuel at Leith, which is quoted 41s. per ton approximately.

Miners Resume at Clackmannan.

A restart has been made at the Brucefield Colliery, Clackmannan. Thirty-four miners have returned to work on pre-strike terms, the men being willing to work at the old rates and to accept the conditions of their employers. It is expected that within a week other men will offer themselves for re-engagement.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Settlement Prospects.

THE outlook for an early settlement of the coal dispute would appear to be as dark as ever, though many express the belief that the end may come suddenly. Hope may be father to the thought, inasmuch as there are no apparent grounds to support it. No one expects that there will be any work this month, but there are rumours current that if the leaders do not effect a settlement soon it is the intention of many of the rank and file to go back to work on their own initiative immediately after the August Bank Holiday. For all the indications that exist as to whether the miners are likely to adopt this course, it may still be said that the stoppage may go on for another two months. All that has happened in responsible quarters during the past week has gone to show that the breach between the miners' leaders and the coalowners is as wide as ever. The intervention of Church leaders is looked at rather askance, and it is difficult to say whether the coalowners or the men's leaders really resent it most. Without for one moment depreciating the efforts of anyone to bring about an agreement, it would almost appear as if people of any and every calling claim the right to step in and have a voice in the affairs of the coal trade. The Executive Council of the South Wales Miners' Federation is in disagreement with its own national Executive, inasmuch as at a meeting on Saturday, the South Wales body passed a resolution to the effect that having before it the intimation that the National Executive had empowered a deputation of Church leaders to approach the Government in order to put before it terms which are in opposition to conference decisions, it instructed its secretary to communicate with the M.F.G.B. Committee urging that the authority to present these proposed terms of settlement should be withdrawn, pending the calling of a national conference to discuss the matter.

Business in Foreign Coals.

During the past week or so a number of steamers have discharged cargoes of continental coals at South Wales ports, and others are due to arrive, while as regards American coals, the ss. Pearlmoor, Baron Fairlie and Gaelic Prince have reached dock, these vessels bringing 9000 tons, 8000 tons and 10,000 tons respectively, all being for the Great Western Railway Company, and being part of the 50,000 tons which this undertaking has purchased. Up to date, the aggregate quantity of American coals arranged since the commencement of the stoppage is close upon 3,000,000 tons for delivery in the United Kingdom. Reports are to hand that the British Government has recently bought a further 300,000 tons, the contract conditions including a penalty clause in case supplies are cancelled in the event of the stoppage in this county being meanwhile terminated. It is also reported that one of the South American railways has purchased about 30,000 tons of American coals, representing business which in normal times would in all probability have come to South Wales. It is further feared that the Egyptian State Railways have contracted for American coals, but definite information is awaited. Tenders for 150,000 metric tons of locomotive coals, Welsh or suitable continental or American coals being admitted, had to be at Cairo for adjudication upon last Saturday. The period of shipment stipulated was August and September. It is reported that Watts, Watts and Co., a firm which has been successful on previous occasions in securing this business for Welsh coals, submitted the lowest tenders, viz., 36s. c.i.f. Alexandria for American coals and 34s. 6d. c.i.f. for Welsh coals, it being provided that in the case of Welsh coals, shipment should commence ten days after the coal stoppage in this country terminates. No definite news has been received as to what the railways have done, except that it is stated that they have purchased coals, probably American. The belief is that the railways have not placed the order for the full 150,000 metric tons, but for only part of it. It is interesting to recall that when in April last the Egyptian State Railways called for prices, the lowest figure put in for Welsh coals was 31s. 5d. c.i.f. Alexandria, but on account of the coal trouble the adjudication was cancelled.

Coal and Patent Fuel Prices.

Supplies of coal for use as bunkers for steamers which are definitely committed to bring back coals to this country are still being released, the price quoted for most descriptions being 30s. per ton. Patent fuel for domestic use still remains at the maximum price of 32s. 6d. per ton at the works, but there is now no restriction upon the price of this commodity for use as bunkers. Makers are therefore asking about 42s. 6d. per ton. Supplies are very scarce, but are likely to be more freely obtainable shortly, as it is reported that supplies of duff coal are being imported from the Continent for the manufacture of fuel.

Ship-repairing Industry.

The ship-repairing industry of this district has suffered severely as the outcome of the coal stoppage. In fact, employers have had a bad time for the past two years. During the financial year ending March 31st last, the Cardiff Channel Dry Docks and Pontoon Company, Ltd., one of the largest undertakings in South Wales, sustained a loss of just over £16,000. Its prospects for the current financial year are therefore even worse in view of the disastrous effect of the coal stoppage on this industry. It is not surprising that the company is taking every possible step to economise, and it has recently reorganised its management at Newport, where it controls the Tredegar Dry Dock and Wharf Company. It has closed its "Channel" office and concentrated the management of both the Tredegar and Channel dry docks at the offices of the Tredegar Company, and in future the Tredegar dry dock will be known as Tredegar No. 1 and the Channel dry dock as Tredegar No. 2 dock. Each of these docks has accommodation for two vessels.

Miners' Executive and Safety Men.

It having been reported that in various places in the coalfield advantage had been taken of the arrangements for the continuance at work of the men necessary for safety purposes by using their services in the production and removal of coal for commercial use, the Executive of the South Wales Miners' Federation resolved on Monday that miners' agents and local officials should make every effort to prevent the abuse in this manner of the safety work arrangements, and to endeavour to prevail upon all workmen to be loyal and not allow themselves to be used by the employers as sources of irritation to their fellow-workmen, thus endangering the peaceful manner in which the struggle with the employers has hitherto been conducted.

Tin-plate Trade.

Conditions in the tin-plate trade are quiet. A few more tin-plate and bar-rolling mills are in operation. The market for stock plates is very steady, with prices at 25s. 6d. to 26s. basis I.C. f.o.b. works port, but supplies for delivery after the coal stoppage are being arranged at 20s. 3d.

Trimmers' Tariff.

A mass meeting of Cardiff, Penarth and Barry coal trimmers, held on Tuesday, at which a report was presented on the negotiations which have taken place with the Shipping Federation on the question of a reduced tariff, decided that the delegates should continue their efforts to obtain a withdrawal of the proposals. Failing that, it was agreed that before any reduction was accepted there should be a ballot of the whole of the members.

The Institution of Civil Engineers.

APRIL EXAMINATIONS, 1926.

PASS LIST.

Preliminary (115).—A. A. A. Abdeldayen, W. G. McD. Anderson, J. A. Andrew, H. G. Andrews, A. L. Archibald, J. Arrol, F. R. L. Barnwell, G. Blackwood, D. Blenkinsop, H. R. Bridger, J. B. R. Brooke, C. V. Brown, H. B. Buckingham, G. C. Bunn, S. A. Burgess, D. M. Cameron, C. W. Cass6, A. W. Chapman, W. C. Clarke, J. V. Cook, R. B. Craig, M. N. Dalal, S. M. Davies, W. P. J. Davison, H. E. Dohoo, H. J. Donovan, G. L. A. Downing, L. A. Drain, A. H. Draz, H. J. Eddie, G. C. N. Elliott, E. W. S. Evans, R. B. Francis, A. H. Freeman, W. A. Fuller, L. J. Goldsmith, E. F. Goodwin, R. T. Goymer, R. H. Greaves, S. A. Green, D. W. Harvey, J. E. Johnson, J. A. Johnston, A. H. Kennard, T. C. Ketchen, E. W. Kinsman, N. Lampitt, E. J. Land, J. R. Langridge, A. C. L. Law, W. B. Lawson, C. F. V. Lawton, F. W. Lindup, C. R. A. Linton, C. R. Lovatt, H. D. S. Lowe, D. McBride, W. G. McCarthy, W. McConnachie, J. B. McGaw, D. McVean, C. A. Massie, J. W. Mills, D. Mitchell, H. Morris, J. Motion, R. C. Mumby, W. H. Newman, H. Newton, W. F. Nicholas, A. J. P. Pashler, J. G. Paterson, R. N. Pegg, J. R. Pilkington, R. J. Pugh, A. M. Quennell, D. H. Ramage, E. Roberts, G. W. Roberts, R. G. S. Roberts, D. Robertson, W. T. Rondel, L. F. Row, E. L. Rushbrooke, G. Rushton, J. C. Russell, E. E. Samuel, J. D. Sharman, J. S. Silver, R. A. Simpson, J. N. Smith, L. E. Snell, J. A. Sturrock, M. W. Summers, G. N. Swayne, K. C. M. Symons, R. E. Taylor, T. S. Taylor, jun., W. Tivendale, R. F. Tucker, G. D. Turnbull, H. P. Turner, W. A. Turner, J. P. Walton, T. D. Watson, H. J. Welch, G. M. Wheat, V. C. Whiting, A. Wilkinson, R. J. Williams, I. H. Wilson, F. Wood, H. W. Wood, D. F. Young, W. Young.

ASSOCIATE MEMBERSHIP (244).

Whole Examination (Sections A, B, and C) (14).—J. L. Beckett, H. Erskine, G. A. Green, H. Halstead, B. F. Holden, H. T. Hough, H. W. Jarvis, M. G. Maycock, E. B. Nisbet, A. K. Pollock, A. B. Porter, K. Scott, T. S. Sinclair, H. Turner.

Sections A and B only (26).—H. S. Andrew, A. N. Burgess, T. F. Burns, J. L. Chapman, J. W. Clark, H. E. T. Compton, A. Cowie, E. Edwards, T. E. Emmett, T. L. Gray, F. F. Horton, J. S. Ireland, R. H. James, J. MacF. MacAlpine, P. M. B. McBain, C. H. McDowell, E. A. Middle, R. J. Nichols, J. Russell, A. C. W. Ryland, R. W. C. Smith, F. R. Speight, D. E. Strachan, F. V. Wickham, T. U. Wilson, K. F. W. Woods.

Sections B and C only (12).—H. A. Anderson, jun., W. S. Catlow, H. K. Cox, H. D. Drummond, G. H. Fretwell, R. W. Hall, H. Haughton, G. Holbourn, R. Mackrill, J. Oldfield, B. Whitteron, A. C. Wilson.

Section A only (37).—F. W. Adie, E. Adlington, E. B. Allinson, J. Baker, N. C. C. Barrell, R. Bates, E. E. Box, C. W. E. Brown, A. C. Burnett, W. H. Burren, L. Carnie, F. H. Coleby, R. Cornish, H. Davies, J. A. L. Denison, J. P. Dockray, A. A. Doig, D. C. Doig, W. A. Doig, H. M. Everett, K. Fraser, C. B. Geake, E. H. Hargrave, M. A. Hasan, C. A. Hayes, N. B. Henderson, R. S. B. Hervey, D. Hide, D. Holdsworth, E. L. Horn, D. J. Howe, J. R. Howe, E. Hoyte, A. R. Jefferson, G. R. Kettlewell, J. McE. King, G. C. Law, J. D. Malcolm, H. Milne, A. Mitchell, F. Morgan, H. F. Noyce, W. T. P. Perkins, G. M. Pickard, A. K. Richards, J. MacM. Riddet, J. G. Shakespeare, F. A. Shorter, I. M. Simmie, G. Slater, J. H. Todd, S. L. Vincent, H. N. Wilford, J. E. Wilson, J. E. Wilson, D. B. Wood, N. Worrall.

Section B only (38).—W. J. Allen, R. A. T. Anderson, R. H. Austin, J. Blackburn, R. Blakeborough, G. H. H. Collins, A. B. Cooper, P. G. Corder, R. H. Cunningham, J. F. Darnbrough, T. S. B. Dick, H. C. E. Dunn, F. Eaves, C. B. Eck, W. S. Evans, W. E. Fecher, E. Gill, J. H. Humphreys, E. Hutton, W. B. Instone, N. V. Jeffery, N. Jervis, G. F. Kent, E. L. Key, H. V. Langley, J. E. Lewis, W. B. Macfarlane, J. A. McManus, L. F. Nicholson, M. W. G. Overton, A. L. Owen, G. Perry, G. A. Phillips, D. D. Thorp, G. W. Warr, L. C. Whiskin, T. Willey, H. Wolf.

☛ *Section C only* (97).—E. K. Adam, B.Sc. (Glas.), H. C. Adams, M.C., B.A. (Cantab.), C. G. Alderton, C. F. Armstrong, B.Sc. (Edin.), H. Atkinson, H. Bailey, W. R. Bailey, B.Eng. (Liverpool), S. R. Banks, B.Eng. (Liverpool), L. P. Bard, B.Sc. Eng. (Lond.), R. Barrett, B.A. (Cantab.), J. F. Bickerton, B.Eng. (Liverpool), A. A. Birch, B.Sc. (Leeds), E. K. Bridge, B.Sc. (Glas.), W. J. N. Bryce, B.Sc. (Glas.), S. J. P. Cambridge, A. H. Cantrell, B.Sc. Eng. (Lond.), A. B. Catling, C. J. Chaplin, B.Sc. Eng. (Lond.), H. Clayton, H. F. Cloke, B.Sc. Eng. (Lond.), C. B. H. Colquhoun, B.Sc. Eng. (Lond.), G. J. L. Cowdell, B.A. (Cantab.), H. F., Cronin, M.C., B.Sc. Eng. (Lond.), A. V. H. Crummack, F. H. Davies, B.Sc. Eng. (Lond.), A. L. Dent, B.Sc. Eng. (Lond.), N. G. Elliot, B.Sc. (Leeds), L. B. Escritt, G. R. Fenton, H. W. Flett, A. Floyd, B.Sc. (Durham), J. A. Formunt, B.Sc. Eng. (Lond.), I. S. Fraser, B.Sc. (Glas.), W. E. Gelson, B.Sc. Eng. (Lond.), H. H. George, B.E. (Sydney), S. K. Gilbert, F. I. S. Gill, J. H. Glendinning, B.Sc. (Belfast), F. W. Goodman, E. R. Green, J. E. Gregory, F. R. Hall, B.Sc. Eng. (Lond.), A. M. Hamilton, B.E. (New Zealand), J. B. F. Hawkins, C. E. M. Herft, G. F. Holdsworth, J. M. M. Howat, J. Y. Hughes, C. R. Hutchinson, B.Sc. (Leeds), F. R. Keene, D. H. Lee, B.Sc. Eng. (Lond.), F. C. L. Lloyd, H. Lloyd-Williams, B.Sc. (Glas.), A. G. McDonald, B.Sc. Eng. (Lond.), I. M. Mackay, B.Sc. (Edin.), J. MacNiven, A. G. Mansell, W. E. Marsh, G. G. Marsland, S. Mehew, B.Sc. Eng. (Lond.), J. E. W. Monkhouse, G. Morgan, B.Sc. (Wales), J. P. Musgrave, B.A. (Cantab.), H. Neal, R. M. Owen, B.A. (Cantab.), J. W. Pallister, C. C. Parkman, J. P. Paton, B.Sc. (Edin.), T. Perkins, B.Sc. Eng. (Lond.), F. J. N. Polkinhorne, B.Sc. Eng. (Lond.), C. R. Porter, T. Porter, S. G. Ronan, B.A.I. (Dubl.), A. Ross, B.Sc. Eng. (Lond.), J. R. Russell, B.Sc. (Edin.), G. G. E. Scribante, F. C. Simmons, B.Sc. (Bristol), A. J. Small, C. R. Smith, B.Sc. (Manchester), J. F. Summersgill, C. K. Thompson, B.Sc. Eng. (Lond.), C. A. M. Thornton, B.A. (Cantab.), F. W. D. Timson, R. V. Trace, C. B. Trye, B. E. A. Vigers, B.A. (Cantab.), F. W. Waddell, C. G. B. Wale, B. E. B. Walker, A. J. B. Wardle, B.Sc. (Birmingham), J. Watt, R. W. Weekes, H. C. Weston, B.Sc. (Glas.), S. White, B.Sc. (Durham), L. G. Wills, B.Sc. Eng. (Lond.), A. Young, B.Sc. (Glas.), W. V. Zinn, B.Sc. Eng. (Lond.).

LAUNCHES AND TRIAL TRIPS.

PASS OF MELFORT, single-screw oil-carrying vessel; built by the Blythswood Shipbuilding Company, Ltd., to the order of the Bulk Oil Steamship Company, Ltd., of London; dimensions, 200ft., 30ft., and 13ft. 7in. moulded depth. Engines, triple-expansion, pressure 180 lb.; constructed by John G. Kincaid and Co., Ltd., of Greenock; launch, July 12th.

CITY OF OXFORD, single-screw steel steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Ellerman Lines, Ltd.; dimensions, 325ft. by 46ft. 2in. by 23ft. 2in.; to carry about 4950 tons on a reasonable draught. Engines, triple expansion, pressure 185 lb.; constructed by the Wallsend Slipway and Engineering Company, Ltd.; launch, July 14th.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—The scrutineers (Messrs. P. M. Baker, A. Murray Coombs, and A. F. Harmer), appointed at the ordinary meeting held on April 22nd, 1926, in connection with the ballot to fill the vacancies which will occur in the Council on September 30th next, have reported to the president that 1420 ballot papers were returned, of which twenty were spoiled, and that the result of the ballot is as follows:—President, Dr. W. H. Eccles, F.R.S.; vice-president, Colonel T. F. Purves, O.B.E.; hon. treasurer, Lieut.-Colonel F. A. Cortez Leigh, T.D., R.E.; ordinary members of Council: (members) Mr. A. C. Cramb, Dr. A. H. Railing, Dr. S. Parker Smith, and Mr. A. J. Stubbs; (associate member) Mr. F. W. Crawter.

RAILWAY WORKSHOPS IN NEW ZEALAND.—In connection with the extensive railway workshop undertakings now in hand in New Zealand a number of contracts have already been let in this country, where it is hoped by the New Zealand Government that virtually the whole of the necessary material will be obtained. Four workshops, one at each of four cities, are included in the scheme, and at present tenders are being invited by the High Commissioner for New Zealand for a new car and wagon workshop at Otahuhu, Auckland. Plans and specifications are on exhibition at the Chambers of Commerce at Glasgow, Manchester, and Birmingham, at the offices of the British Engineers' Association, the Board of Trade, London, and the office of the High Commissioner for New Zealand, 415, Strand, London, W.C. 2. A sum of about one and a-half millions sterling is involved in the general scheme. Tenders are similarly being invited for remodelling undertakings at the workshops at Addington (Christchurch) and Hillside (Dunedin).

WHITWORTH SOCIETY.—The third summer meeting of the Whitworth Society was held in Manchester on Wednesday, the 14th inst., when, by the courtesy of Charles Day (Mirrlees, Bickerton and Day, Ltd., Stockport), about forty members were conveyed by chars-à-banc to the works, there inspected the construction of various types of Diesel engines, took luncheon in the canteen and were afterwards taken by chars-à-banc to the Openshaw Works of Sir W. G. Armstrong, Whitworth and Co., Ltd., where a party over fifty in number was welcomed by Mr. C. G. Falkner, the local secretary. They were shown round the works, took tea in the canteen, and returned to Manchester. In the evening the president, Mr. Wm. Sisson, Gloucester, received forty-four members at the Engineers' Club, Albert-square, Manchester, where they dined together. Dr. F. P. Purvis, the president-elect, was unable to be present through ill-health, but his address was read from the chair, and it is hoped that he will be present at the December dinner. The roll of the Society now contains 497 names, and full particulars may be obtained from the Hon. Secretary, Whitworth Society, c/o the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1.

SAFETY IN MINES RESEARCH BOARD.—The fourth annual report of the Safety in Mines Research Board, covering the year 1925, has just been published (H.M. Stationery Office, price 1s. net). The report is mainly devoted to brief accounts of the progress of the numerous researches which are being carried out either directly under the Board or Committees of the Board or at universities and other centres with the aid of funds supplied by the Board. The Board has now two experimental stations, one at Sheffield for laboratory work and one at Buxton (formerly at Eskmeals), chiefly for large-scale work. The scientific and technical staff numbers about fifty. The total annual expenditure on these researches approaches £50,000 and is mainly defrayed out of the Miners' Welfare Fund. The subjects of research include problems relating to coal dust explosions, firedamp explosions, spontaneous combustion of coal, the safe use of electricity in coal mines, mining explosives, safety lamps, devices for trapping dust generated by rock drills, falls of ground, wire ropes and the control of mine temperatures. Eleven reports have been published by the Board during the year, and a list is given of many other papers relating to the researches written by members of the staff and published in scientific journals, &c. A report on the co-operative research which has been arranged between the Safety in Mines Research Board and the United States Bureau of Mines is given in an appendix, and there is a note describing the organisation of mining research in the U.S.A. The report also embodies an account of the progress of the health inquiries carried on under the supervision of the Health Advisory Committee, notably the inquiries with regard to the injurious effects of certain rock dusts.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 0 0	—
No. 1 Foundry	4 8 0 to 4 10 0	
No. 3 Foundry	4 3 0 to 4 5 0	
N.E. COAST—		
Hematite Mixed Nos.	4 1 0	4 1 0
No. 1	4 1 6	4 1 6
Cleveland—		
No. 1	4 10 0	4 10 6
Silicious Iron	4 10 0	4 10 6
No. 3 G.M.B.	4 7 6	4 8 0
No. 4 Foundry	4 6 6	4 7 0
No. 4 Forge	4 6 0	4 6 6
Mottled	4 5 6	4 6 0
White	4 5 6	4 6 0
MID.-LANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 5 0 to 3 10 0	
,, Forge	2 16 0 to 2 17 0	
(3) Derbyshire—	(*None offered.*)	
No. 3 Foundry	3 7 6 to 3 15 0	
Forge	3 2 0 to 3 5 0	
(3) Lincolnshire—	(*None offered.*)	
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 8 6 (a) to 4 16 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 5 0	11 0 0
Best	—	—
N.E. COAST—		
Common Bars	11 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—	(*Prices nominal.*)	
Crown Bars	11 5 0 to 11 10 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 10 10 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up	7 7 6	7 0 0
Sections	7 12 6	6 5 0
Steel Sheets, under 3/16in. to ½in.	10 10 0 to 11 10 0	
Sheets (Gal. Cor. 24 B.G.)	—	£16 15 0 to £17 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	7 17 6	—
Angles	7 10 0	—
Boiler Plates	11 10 0	—
Joists	7 10 0	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†	—
Light Rails	8 5 0 to 8 10 0	
Billets	8 0 0 to 10 10 0†	
MANCHESTER—		
Bars (Round)	9 5 0	—
,, (others)	9 0 0	—
Hoops (Best)	13 5 0	13 0 0
,, (Soft Steel)	10 0 0	9 15 0
Plates	8 2 6	—
,, (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	11 0 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	7 5 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 5 0	
Billets and Sheet Bars	6 2 6 to 6 7 6	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 0 0 to 17 10 0	
Angles	7 2 6 to 7 10 0	
Joists	7 2 6 to 7 10 0	
Tees	8 2 6 to 8 10 0	
Bridge and Tank Plates	7 17 6 to 8 2 6	
Boiler Plates	11 0 0 to 11 15 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	20/3 to 20/–
Block Tin (cash)	285 0 0
,, (three months)	282 15 0
Copper (cash)	57 17 6
,, (three months)	58 12 6
Spanish Lead (cash)	32 8 9
,, (three months)	32 1 3
Spelter (cash)	34 0 0
,, (three months)	34 8 9
MANCHESTER—	
Copper, Best Selected Ingots	64 12 6
,, Electrolytic	66 7 6
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 0½
Brass Tubes (Basis Price)	0 0 11½
,, Condenser	0 1 2
Lead, English	33 10 0
,, Foreign	32 12 6
Spelter	34 17 6

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 10 0	7/6
,, 6 p.c. to 8 p.c. ,,	£22 0 0	7/3
,, 8 p.c. to 10 p.c. ,,	£20 15 0	6/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£38 10 0	12/6
,, ,, 1 p.c. ,,	£44 10 0	15/–
,, ,, 0·70 p.c. carbon	£54 10 0	17/6
,, ,, carbon free	1/5½d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 5 0 scale 5/– per unit	
,, ,, 75 p.c.	£20 10 0 scale 6/– per unit	
,, Vanadium	15/– per lb.	
,, Molybdenum	6/– per lb.	
,, Titanium (carbon free)	0/11 per lb.	
Nickel (per ton)	£170	
Cobalt	10/– per lb.	
Aluminium (per ton)	£112	

FUELS.

SCOTLAND.

	(*Prices nominal.*)	Export.
LANARKSHIRE—		
(f.o.b. Glasgow)—	Steam	15/9
,, ,,	Ell	16/6
,, ,,	Splint	16/6 to 17/–
,, ,,	Trebles	15/9
,, ,,	Doubles	14/– to 14/6
,, ,,	Singles	13/9
AYRSHIRE—		
(f.o.b. Ports)—	Steam	16/9
,, ,,	Jewel	17/– to 17/6
,, ,,	Trebles	17/–
FIFESHIRE—		
(f.o.b. Methil or Burntisland)—	Steam	12/6 to 14/9
Screened Navigation		21/–
Trebles		14/– to 15/–
Doubles		14/–
Singles		13/– to 13/6
LOTHIANS		
(f.o.b. Leith)—	Best Steam	14/– to 14/3
Secondary Steam		13/6
Trebles		14/6 to 14/9
Doubles		13/6
Singles		13/6

ENGLAND.

	Export.
(8) N.W. COAST—	
Steams	*No quotation*
Household	,, ,,
Coke	,, ,,
NORTHUMBERLAND—	
Best Steams	16/–
Second Steams	14/6 to 15/–
Steam Smalls	8/– to 8/6
Unscreened	13/– to 13/6
Household	20/– to 22/–
DURHAM—	
Best Gas	18/6 to 19/–
Second	15/– to 16/6
Household	20/– to 22/–
Foundry Coke	18/– to 20/–

SHEFFIELD	Inland. (*Nominal: none on offer.*)	
Best Hand-picked Branch	31/– to 34/–	—
Barnsley Best Silkstone	28/– to 30/–	—
Derbyshire Best Brights	26/– to 28/–	—
,, ,, House	24/– to 25/–	—
,, ,, Large Nuts	17/– to 20/–	—
,, ,, Small	12/6 to 14/–	—
Yorkshire Hards	17/– to 19/6	—
Derbyshire Hards	16/– to 19/–	—
Rough Slacks	10/– to 12/6	—
Nutty Slacks	7/6 to 9/–	—
Smalls	3/6 to 6/–	—
Blast-furnace Coke (Inland)*	—	—
,, ,, (Export)	f.o.b.	16/– to 17/–

(9) SOUTH WALES.

(*All prices nominal.*)

CARDIFF— Steam Coals:	
Best Smokeless Large	26/– to 27/–
Second ,, ,,	24/6 to 25/6
Best Dry Large	24/– to 25/–
Ordinary Dry Large	21/– to 22/–
Best Black Vein Large	25/6 to 26/–
Western Valley Large	24/6 to 25/–
Best Eastern Valley Large	24/– to 25/–
Ordinary ,, ,,	23/6 to 24/–
Best Steam Smalls	17/– to 18/–
Ordinary ,,	16/– to 17/–
Washed Nuts	19/– to 20/–
No. 3 Rhondda Large	26/6 to 27/–
,, ,, Smalls	18/– to 18/6
No. 2 ,, Large	24/– to 25/–
,, ,, Through	20/– to 21/–
,, ,, Smalls	15/– to 16/–
Foundry Coke (export)	40/– to 50/–
Furnace Coke (export)	25/– to 30/–
Patent Fuel	32/6 to 33/6
Pitwood (ex ship)	26/6 to 27/6
SWANSEA— Anthracite Coals:	
Best Big Vein Large	39/– to 40/–
Seconds	32/6 to 35/–
Red Vein	27/– to 29/–
Machine-made Cobbles	47/6 to 50/–
Nuts	47/6 to 50/–
Beans	42/6 to 44/–
Peas	23/– to 25/–
Breaker Duff	7/6 to 8/–
Rubbly Culm	12/6 to 13/6
Steam Coals:	
Large	22/6 to 24/6
Seconds	20/– to 22/–
Smalls	11/– to 15/–
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/–, with fluctuations according to analysis; open market 17/6 to 19/– at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham

French Engineering Notes.

(From our Correspondent in Paris.)

The Industrial Situation.

THE problem which confronts manufacturers of how to carry on business is becoming more difficult of solution every week. Ordinary business methods can be employed no longer, for with the accelerated fall of the franc prices are rapidly advancing, and, as there exists no stable basis at home for fixing them, prices are rising in chaotic movements. No one can do business when it is impossible to foresee what is going to happen. The only thing that immediately concerns makers is to cover their requirements in raw material as far forward as possible; but iron and steel producers are themselves changing their methods and are beginning to restrict, and even refuse credits, while most of them have agreed to apply export prices to the home market as offering the only basis which will give them some security. For some time past, iron and steel producers have found it necessary to come more into line with the rates ruling in foreign markets. Export prices are therefore steadily tending towards the gold basis, and there is no doubt that home prices will follow this lead. There is certainly less fear than formerly of any "dumping" being favoured by a depreciated currency. The trade returns continue to show that the selling of goods abroad at low prices, when so much more has to be paid for imported raw material, merely impoverishes the country. During the first six months of the year, for example, the value of imports was estimated at 29,414 million francs, an increase of 10,404 million francs as compared with the first half of 1925. As the weight was 23,404,480 tons, an augmentation of only 565,234 tons, it will be observable that the French had to pay considerably more for the foodstuffs and raw material they were obliged to import. The value of exports was returned as 26,723 million francs, an increase of 5142 million francs. Manufactured goods accounted for 16,981 million francs. The weight of exports was 15,904,336 tons, an increase of 819,453 tons. The balance of trade has become unfavourable because more francs have to be paid for a given quantity of imports, and manufacturers find that they are not getting enough for what they export. They see that the business is not profitable to them or to the country. Consequently, prices must be advanced to somewhere near the international level. Business at home is still less profitable, to the extent that locomotive and wagon builders who have contracts in hand are clamouring for a revision of prices which the railways are not inclined to entertain. As regards new business, it may be said that in the engineering trades there is scarcely any at all. The State is giving out no new orders, and has temporarily suspended all the public works and other undertakings it had in hand.

Railway Amalgamation.

There have been rumours for some time past that the Midi Railway Company and the Paris–Orleans Railway Company have decided to amalgamate, with a view of bringing the two systems under one management and thereby insuring economies in working costs. Such action would doubtless find favour under ordinary circumstances, but it is being critisised by users of the Orleans line who affirm that it is intended to place the two systems under the management mainly of the Midi directors, and it is feared that political influences in favour of the populations in the south of France will be detrimental to the interests of those living in the valley of the Loire. In other words, it is stated that railway rates may be adjusted to benefit the Midi users rather than the Orleans. So long as the railways are under the influence of political parties, it will always be difficult to come to an understanding, and an agitation is being carried on by the Orleans users to insure that nothing shall be done before the proposed amalgamation is discussed in Parliament.

Concrete Suspension Bridge.

At Peseux, on the Doubs, it was found necessary to replace an old suspension bridge, and out of twenty-three different projects submitted, it was decided to adopt a reinforced concrete structure, on account both of its cheapness and of its extremely simple design. The two piers are built on concrete piles, some of them driven to as much as 16 m. in the bed of the river. The three arches are parabolic and support the roadway with cables. The distance between the piers is 137 m. The width of the bridge is 4·40 m. The concrete employed was made with the quick-hardening *ciment fondu*.

Home Fuels.

So much has already been done in the way of providing motor users with home-produced fuels, that it has been decided to carry out some extensive road trials during September with vehicles of all kinds employing fuels of purely national origin. There must be no mixture with imported petrol or oils. Starting from Paris, the vehicles will cover in ten days an extensive circuit in Normandy and the north of France. Many kinds of fuels will be employed in this demonstration, including a convenient form of compressed charcoal, very hard and clean, which was shown recently at the Ecole des Mines by Professor Goutal. For the moment, charcoal is the only national fuel which has given really practical results, and the Government offered further encouragement, recently, to owners of vehicles equipped with suction gas plants by reducing the taxes on them by 50 per cent. on condition that the engines were not fitted with carburetters that would enable them to run entirely on petrol. Not only has the national fuel problem entered upon an interesting stage, on account largely of the results obtained with alcohol synthetically produced with catalysers, but it is probable that new developments will take place in engine design following upon the experiments of Monsieur Dumanois for giving an effect of expansion to the petrol engine. This was first accomplished by chemical means, but Monsieur Dumanois has now made a special form of piston which, immediately after the initial explosion, apparently presents a larger piston area. The system is claimed to insure a notable economy in petrol consumption.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

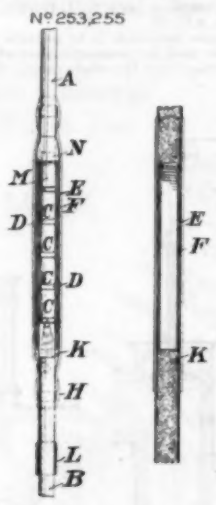
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TELEGRAPHS AND TELEPHONES.

253,255. March 27th, 1925.—IMPROVEMENTS IN ELECTRIC CABLES, Siemens Brothers and Co., Ltd., of Caxton House, Tothill-street, London, S.W. 1; Arthur Ernest Foster, of Fairlawn, Old Charlton, London, S.E. 7; and Henry Gurney Wood, of 40, Beech-hill-road, Eltham, London, S.E. 9.

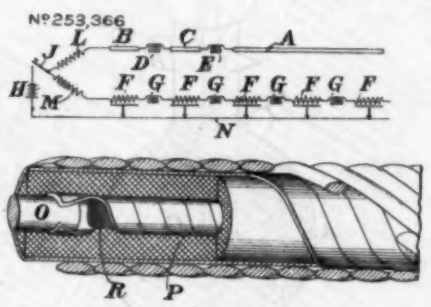
This invention relates to telephone and other signalling cables of the coil loaded type, and relates more particula ly to the insertion and protection of the loading coils in lead-cased cables which are used under water. The two lengths of lead-sheathed cable between which the coils are inserted are indicated at A and B. The loading coils are shown diagrammatically as cylinders C. The coils are spaced apart by insulating separators, such as D. The lead sheath protecting the coils is shown at E. A reinforcing helix of wire is provided at F. The turns of the helix are slightly separated so that longitudinal bending of the sheath may take place. The sheath is attached to the sheathing of the cable lengths, or the two parts of a small length, by plumbing as shown at H. Between the wire helix and the lead



sheath there is an open lattice or braid of wire K, which continues beyond the lead sheath, and together with the sheath is plumbed to the adjacent sheating, as shown at H; or this lattice may be continued beyond the place of plumbing H and attached by soldering and by binding, as shown at L. The purpose of the braiding is to prevent or reduce undue elongation under tension at the place of insertion of the coils. The conductor wires issuing from the cable parts may be protected by split moulded pieces of insulating material, which enclose them, and thus safeguard these connections. These moulded pieces are inserted at M, and additional pieces may be inserted at N, on to which the sheathing is brought down by a rotating or sliding clamp. The right-hand illustration shows a section of the reinforced sheath alone, as it would be before being applied at the place of insertion of the coils. A middle portion of the braid K is cut away to show the wire helix. In forming the sheath the helix is first made up on a split mandrel which can be withdrawn and the requisite length of braid is drawn over the helix. The assembled body is then passed through a lead press to bring on the lead sheath.—*June 17th*, 1926.

253,366. June 29th, 1925.—IMPROVEMENTS IN OR RELATING TO ELECTRIC CABLES, Muirhead and Co., Ltd., and Benjamin Davies, both of Croydon-road, Elmers End, Beckenham, Kent.

This invention relates to loaded electrical cables, such as are used for duplex working in conjunction with an artificial line. In such cables it is necessary that there should be correspondence between the characteristics of the cable and those of the artificial line, and it is essential that this correspondence should be more exact in the vicinity of the ends of the cable and line respectively

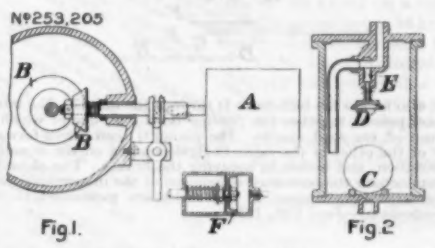


than is necessary in the case of their middle sections. The improved cable comprises a central uniformly loaded section A and end sections, one of which is shown comprising unloaded portions B and C, together with loading coils D and E, placed intermittently. The co-operating artificial line is made up of unloaded sections F alternating with loading coils G. Connections to the battery H and transmission key J are indicated at L and M, the earth line being shown at N. The lengths of the loaded and unloaded portions are dependent upon the speed at which signals are passed through the cable, the average relative lengths being, however, normally of the ratio of 1 to 80; thus the loaded portion of the cable may be 100 yards long and the unloaded portion 4 to 5 miles long. Any desired system or form of loading coils may be employed. Owing, however, to the high permeability of the metal known by the registered trade mark "Mumetal" and other alloys now obtainable, it is possible to construct such a cable so that the diameter of the loaded portion is not greater than that of the unloaded portion. Such a construction of cable is illustrated in the lower illustration, in which the copper conductor of an unloaded portion is represented at O, while the loaded portion consists of a helix P of copper ribbon wound around a core R of material of high magnetic permeability from which the helix P is insulated. A suitable electrical connection is made by such means as soldering between the copper conductor O and the helix P, and it will be seen that the core R may be made of such a diameter that the outside diameter of the helix is little, if at all, greater than that of the conductor O, and that therefore the total diameter of the cable may be the same over the loaded and unloaded portions.—*June 17th*, 1926.

PUMPING AND BLOWING MACHINERY.

253,205. March 13th, 1925.—PRIMING OF PUMPS, J. Stone and Co., Ltd., Deptford; H. C. Hodgson, 20, Cathcart-hill, Highgate, London, N.; and A. L. Paramor, 37, Fairholme-road, West Kensington, London, W. 14.

This device is intended for use in conjunction with centrifugal pumps which are primed by means of an exhauster driven off the main pump shaft. The exhauster is indicated at A and is driven by the friction bevel wheels B B. In the pipe which connects the exhauster with the casing of the main pump, there

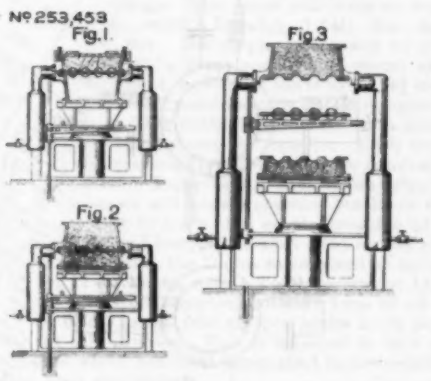


is arranged the valve shown in Fig. 2. When the exhauster has drawn all the air out of the pump and water follows, the float C rises and, meeting the cup D, closes the slide valve E, so that the water cannot gain access to the exhauster. When the pump is in operation the float C may sink on to its seating again, and prevent air leaking into the pump. When the pump is running, pressure water pushes forward the piston F—Fig. 1—and declutches the driving wheels, so that the exhauster stops.—*June 14th*, 1926.

MACHINE TOOLS AND SHOP APPLIANCES.

253,453. January 22nd, 1926.—MACHINE MOULDING, *E. C. R. Marks*, 57, *Lincoln's Inn-fields, London, W.C.* 2.

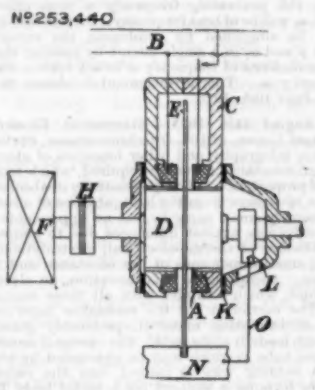
This invention covers a process for the production of moulds for casting objects from pattern plates on a jolting machine. The flask is first assembled as shown in Fig. 1, upside down, and that side is filled and rammed by jolting. The ramming is



thoroughly done, and then the flask is inverted as shown in Fig. 2. The top half is then filled and rammed, and the two halves of the flask are separated, as shown in Fig. 3. The pattern plate is raised and swung aside, and the two halves of the mould then brought together again. Finally, the flask is lifted off the mould, which can then be taken away on the drag-board, and the process can be repeated.—*June 17th*, 1926.

253,440. December 18th, 1925.—IMPROVEMENTS IN THE ART OF AND APPARATUS FOR CUTTING METAL BY ELECTRODE DISCS OR THE LIKE, *Elektrotrennmaschinen Gesellschaft mit beschränkter Haftung, of 3, Baumwall, Hamburg, Germany.*

This invention relates to cutting metals with the aid of an



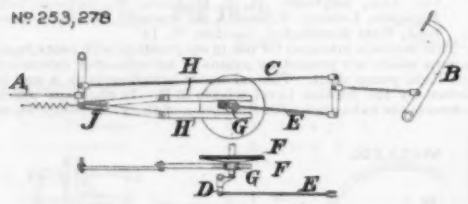
electrode in the form of a disc operating at the speed usual for a high-speed friction saw. The improvement resides in the feature that the electric current supplied to the cutting point is generated by induction in the rotating electrode disc. The apparatus

comprises a unipolar generator, the stator windings A of which are excited from the network or mains B. These coils are mounted in an iron yoke C, and the rotor D carries the disc electrode E, embraced by the windings A. The rotor is driven by an electromotor F. It is preferably insulated from the earth by interposition of an insulating disc H in the driving connection and by insulating discs K between the bearing members and the earthed iron yoke C. The current is collected at the circumference of the disc E and by a brush L, which rubs on a slip ring on the rotor spindle, which is connected to the disc E as well as to the work N by a cable O.—*June 17th*, 1926.

MOTOR CARS AND ROAD TRAFFIC.

253,278. April 8th, 1925.—SERVO BRAKE-OPERATING MECHANISM, T. B. Murray and the Albion Motor Car Company, Ltd., South-street, Scotstoun, Renfrew.

In this braking gear part of the necessary force is produced by the momentum of the vehicle itself. The rod which applies the brakes is shown at A, and it is connected with the foot pedal B by the linkage shown. When the pedal is depressed, it tends to put on the brakes through the intervention of the link C

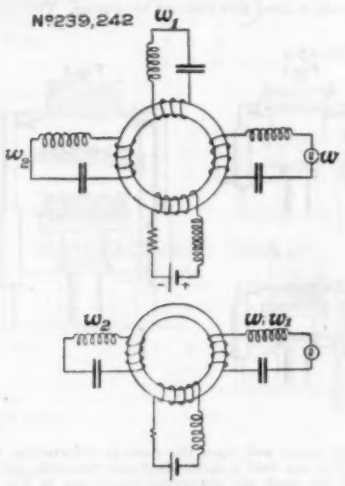


and also moves the bell crank D through the link E. The latter action presses together the friction discs F F, one of which is driven off the road wheels. The pinion G then draws forward one or the other of the racks H H, depending on the direction of rotation, and assists in applying the brakes. The slots J J accommodate the backward movement of the inoperative rack. Alternative mechanisms to the racks are mentioned in the specification.—*June 17th*, 1926.

MISCELLANEOUS.

239,242. August 31st, 1925.—IMPROVEMENTS IN OR RELATING TO FREQUENCY CHANGERS FOR ELECTRIC CURRENTS, Telefunken Gesellschaft für Drahtlose Telegraphie, m.b.H., of 9, Tempelhofer Ufer, Berlin.

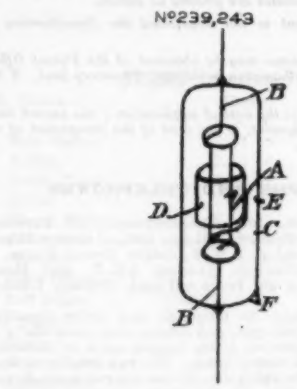
This invention relates to improvements in frequency changers, and more particularly to non-rotary frequency changers of the iron core transformer type. Oscillating circuits are arranged to act from a common magnetic core, and the circuits are so dimensioned that their natural frequencies are linearly related to one another, the term linearly related applying to quantities with values such that one of the quantities is equal to the sum of the others or to the sum of multiples thereof. The circuit of the highest natural frequency contains the prime or generating oscillations, and the other circuits are tuned to the lower frequencies. The upper diagram shows three oscillating cir-



cuits each having a coil mounted upon a common ring-shaped iron core. One circuit contains a generator of prime oscillations of frequency ω. A second circuit separately magnetises the iron core from a battery, while in the other two circuits frequencies ω_1 and ω_2 are directly generated. If separate magnetisation of the core be dispensed with, it is possible to obtain frequencies ω_1 and ω_2 from a frequency ω, such that the relationship $\omega_1 + \omega_2 = \omega$ holds. No self-subsisting oscillation, however, takes place in this case. When the frequency ω_1 approaches the generating frequency ω beat effect may be utilised and ω_2 will be of beat frequency. In this case the arrangement may be simplified by combining the circuits for the frequencies ω and ω_1 in a single circuit by causing the generator of prime oscillations of frequency ω to act upon a circuit tuned to a frequency ω_1. This arrangement is shown in the lower diagram.—*June 10th*, 1926.

239,243. August 31st, 1925.—ELECTRICAL RESISTANCE, Dr. Siegmund Loewe, of 108, Gitschinerstrasse, Berlin, S.W. 61.

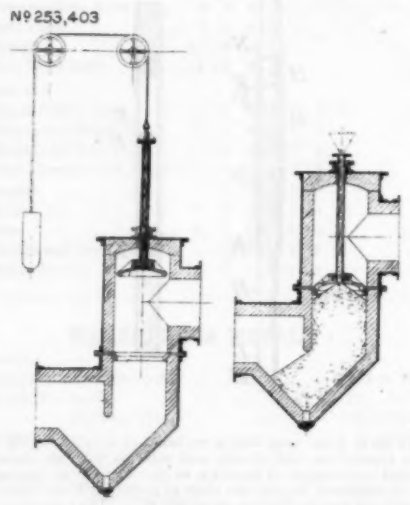
In wireless telegraphy and other branches of electrical engineering, high-resistance units are required, which must combine a number of properties, consisting essentially in absolute independence of the resistance from the load, absence of electrical after-effects, extremely small capacity and no appreciable self-induction, insensitiveness against influences due to temperature and moisture, absence of thermo-electrical, electrolytical or fritter-like effects, small dimensions of the resistance and low cost of manufacture. According to this invention, an electrical high-resistance unit, which complies with all these requirements, is devised. The carrier A for the resistance layer consists of a small rod of insulating material, preferably glass, which is provided with leads B at its ends. The carrier is mounted within an evacuated tube E which may be evacuated by the pumping stud F. A holding wire is melted into the carrier A, this holding wire forming a support for a metal body D, which is mounted in proximity to the carrier A, preferably in form of a closed cylindrical body surrounding it. This metal cylinder D may consist of a sheet of nickel, which has been superficially alloyed with vapour of magnesium. If the cylinder is heated



heating the cylinder D by means of eddy currents. These eddy currents in the cylinder D may be produced by placing the tube E together with the carrier A and the cylinder D within a coil, which carries strong currents of high frequency.—*June 17th*, 1926.

253,403. October 17th, 1925.—GAS VALVES, The South Metropolitan Gas Company, and W. J. Burton, 709, Old Kent-road, London, S.E. 15.

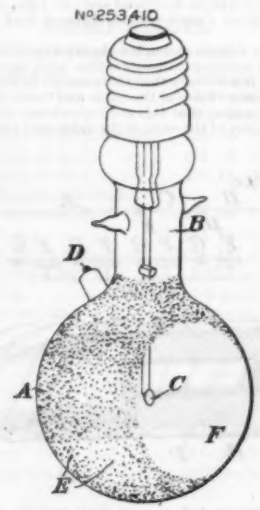
The object of this invention is to provide means for overhauling the valves used for connecting retorts with their gas main without shutting down the whole range. The spindle of the



valve is consequently made hollow, and a pocket is arranged below the valve. If it is desired to dismantle the valve, a plug in the hollow spindle is removed and the cavity is filled with sand or some such material, as shown. A plug is provided in the bottom of the cavity for the withdrawal of the sand.—*June 17th*, 1926.

253,410. October 29th, 1925.—IMPROVEMENTS IN PHOTO-ELECTRIC CELLS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

A photo-electric cell constructed in accordance with this invention is illustrated. It consists of a container having a bulb portion A, a neck portion B, an anode C, and the usual cathode connection D. In the process of manufacture, small glass particles E capable of passing through a 40 mesh sieve, made up



of ·0082in. diameter wires, but retained by a 60 mesh sieve (the wires of which are of ·0067in. diameter) are introduced into the bulb through the neck portion B. The bulb is then heated and revolved slowly. In this manner the glass particles are evenly distributed over substantially the entire inner surface of the bulb, and fused thereto and to each other. In producing the roughened surface of the cell care is taken, however, to keep the glass particles away from the smooth window portion F of the cell. After the interior surface of the bulb has been roughened in the manner indicated, the container is evacuated and a coating of silver applied to the roughened surface. A coating of potassium is then applied to the silvered surface, and formed by passing a glow discharge in hydrogen. The hydrogen is finally displaced and replaced by argon.—*June 17th*, 1926.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

CONGRESS OF CHEMISTS.—In London. For programme, see page 646.

SATURDAY, JULY 24TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Joint meeting of the South-Eastern and Metropolitan Districts at Kemsley village, near Sittingbourne. Motor coaches leave Charing Cross Underground Station (Thames Embankment), 10 a.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Western District meeting at Paignton. 11 a.m.

THURSDAY, AUGUST 5TH.

CRYSTAL PALACE SCHOOL OF PRACTICAL ENGINEERING.—The Crystal Palace. One hundred and sixty-first award of certificates. 3 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE *Telephone Engineer*, of Chicago, asks us to announce that it has moved its office to 225, North Michigan-avenue, in that city.

VICKERS LTD. ask us to announce that Mr. A. Cartwright has been appointed a director, and Mr. G. G. Sim has been appointed secretary of that company.

GRIMSTON, PRICHARD AND PLUTTE, Ltd., of 83, Queen-street, London, E.C. 4, are, we are requested to announce, agents in this country for Helvetica (M.K.W.) ball and roller bearings.

MR. AND MRS. ROBERT W. DANA desire to thank members of the Institution of Naval Architects who sent kind messages of congratulation on the completion of Mr. Dana's twenty-five years' service as secretary of the Institution.

R. AND W. HAWTHORN, LESLIE AND CO., Ltd., of St. Peter's Works, Newcastle-on-Tyne, ask us to announce that the address of their London office has been changed from 3a, Dean's-yard, to 54, Victoria-street, Westminster, S.W. 1.

WE are asked to announce that Mr. Harry Stevenson has been elected chairman of Allen-Liversidge, Ltd., in succession to the late Mr. C. S. Gilman. Mr. Harry Stevenson has been a director of the company since 1910, and has acted as deputy chairman since 1917.

CONTRACTS.

ALLOY WELDING PROCESSES, Ltd., of 14–16, Church-street, Islington, London, N.1, have received an order from the India Store Department for six months' supplies of electrodes for electric arc welding for the Great Indian Peninsular Railway, India.

FULLER'S UNITED ELECTRIC WORKS, Ltd., of Chadwell Heath, Essex, has received a further order for 1346 TG 13 type train lighting cells, each of 180 ampère-hour capacity, for the Bombay, Baroda and Central India Railway, these cells being additional to 736 in hand for that railway at the present time.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., of Rugby, has received an order for six electric motor-driven centrifugal blowers, which will be the largest so far manufactured in this country. They will be used on two motor ships which John Brown and Co., Ltd., of Clydebank, are building for the New Zealand Shipping Company, Ltd., and each blower will have a capacity of 42,500 cubic feet of free air per minute against a pressure of 2·17 lb. per square inch gauge. The electric driving motor for each blower unit is rated at 600 horse-power, 220 volts, 2900 revolutions per minute.

IT is officially announced by the Great Western Railway Company that the following contracts have been placed :—(*a*) Supply of 18 motor omnibus bodies—John Buckingham, Ltd., 332, Bradford-street, Birmingham ; (*b*) supply of nine 30 cwt. motor cartage chassis—John I. Thornycroft and Co., Ltd., Smith-square, London, S.W. 1 ; (*c*) supply of a "Sentinel" locomotive—Sentinel Wagon Works, Ltd., Iddesleigh House, Caxton-street, S.W. 1 ; (*d*) cleaning and painting of cranes, bridges, buildings, &c., at Swansea Docks—Messrs. W. R. Payne and Sons, Belfast House, Shipley, Yorks. ; (*e*) overhaul of dredger Robert Vassal—Messrs. Bailey, Graham and Co., Newport, Mon. ; (*f*) annual overhaul of ss. Richard Grenville—The Bickle Engineering Company, Plymouth ; (*g*) overhaul of tug Horace—Messrs. Bailey, Graham and Co., Newport, Mon. ; (*h*) supply of a 12-ton steam travelling crane for Stourport—Isles, Ltd., Stanningley, near Leeds ; (*j*) supply of an engine weighbridge at Caerphilly—H. Pooley and Son, Ltd., John Bright-street, Birmingham ; (*k*) improvements in accommodation at Llanelly Station—John Lysaght, Ltd., St. Vincent's Ironworks, Bristol ; (*l*) excavating at Old Gaol site, Wapping Wharf, Bristol—Mr. Hy. Smith, 55, Fields-road, Newport, Mon. ; (*m*) construction of bridge under the West Ealing Loop at Groenford—Roads and Public Works, Ltd., 15, Dartmouth-street, S.W. 1 ; and (*n*) new platform covering and other works at Cardiff Docks Station—Price and Morgan, Ltd., 75A, Wyverne-road, Cardiff.

WE are informed that the organising committee of the Public Works, Roads and Transport Congress and Exhibition has decided to offer prizes for papers which are submitted for the discussions at the Congress in November, 1927. Particulars may be obtained from the Secretary, 84, Eccleston-square, S.W. 1.

WE have been asked to draw attention to the existence of a general testimonial fund, initiated by the Metallurgical Society of the University of Birmingham, on the occasion of the retirement of Professor Turner from the Chair of Metallurgy. Full particulars and forms of subscription may be obtained from the Hon. Sec., Turner Testimonial Committee, the University, Edgbaston, Birmingham.